From Curation to Collaboration

A Framework for Interactions in Cultural Heritage Information Systems

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Abstract

From Curation to Collaboration - A Framework for Interactions in Cultural Heritage Information Systems
by Juliane Stiller

Through digitization of cultural heritage and online access to it, memory institutions such as museums, libraries and archives can provide new instruments for engaging users with cultural heritage. Most institutions have seized the opportunity to revive their hidden heritage by digitizing objects and publishing and displaying a digital surrogate on a website or in a web-based information system. Unlocking the potential of the vast amount of cultural heritage material and making it accessible is the challenge memory institutions are currently facing. The goal is to draw in an enthusiastic audience that appreciates the cultural material and interacts with it through the means of the digital medium. To achieve this, access functionalities need to be in place. Additionally, the context of the artifact needs to be preserved. Ideally, digital artifacts should be self-explanatory, providing the user with endless possibilities of how to interact with them. But in reality, institutions often do not have an answer to the question what purposeful interactions with digital cultural heritage should entail.

The thesis describes interactions in cultural heritage information systems and links them to access points of the digital material. Based on use cases and a grounded theory approach for data analysis, a framework for interactions was developed. Seven interrelated classes of interactions center around the origin of the digital objects, curational user activities and the support of community building by setting incentives for purposeful contributions. This categorization of interactions was complemented by a second dimension that determines the level or degree of interactions in each class on an ordinal scale of five degrees, namely *Basic Functionality*, *Organization*, *Enrichment*, *Contextualization* and *Collaboration*. *Basic Functionality* constitutes the foundation of every interaction. With increasing complexity, each interaction class reaches the next higher level ideally ending in *Collaboration* - the highest degree is characterized by collective activities and groups of people working together. The degrees relate interactions to the access modes *Search*, *Browse* and *Engage*. The more complex and collaborative the interactions get, the more access points are created which in turn improves the accessibility of the system.

The developed framework for interactions offers a holistic approach to understand interactions and their interplay with information access. The interrelatedness allows stakeholders in cultural heritage institu-

tions to understand that each decision in the information design influences how users access and interact with digital material. The framework does not only deliver a vocabulary to discuss interactions and their purpose in cultural heritage information systems, but also manifests a vision on how they should be developed to enable goal-oriented activities. It is set out to assess the present situation, compare systems and give recommendations for purposeful future interactions that could be implemented.

The framework was used in a content analysis of 72 cultural heritage systems that were clustered according to their characteristics. The outcome revealed shortcomings and pinned down peculiarities between the groups *Museums*, *Libraries*, *Archives*, *Aggregators*, *Collections* and *Communities*. This improved the understanding of cultural heritage information systems exposing common unfavorable system design patterns that need to be challenged. For example, this analysis revealed that museums strive for engaging experiences such as offering user exhibitions, but often neglect the social aspect ending up with features that are hardly used. Focusing on collaborative structures that value the user contribution and embed it into the existing content could help museums to make their offered interactions more purposeful and therefore more used.

In a next step, the framework was applied as a tool for evaluation to help shape effective system design that guides the implementation of purposeful interactions. For that, one system per cultural heritage group was chosen as a use case for the evaluation. The outcomes were recommendations for a more effective system design that acknowledges the impact of interactions on the access modes. Based on the dimensions content, access, environment and goals, results and recommendations were listed that inform purposeful interactions. For example, to support and encourage user engagement, cultural institutions should strive for collaboration in their curational activities. This ensures building an active community where abuse and misuse cannot gain a foothold and consequently leads to more access points all users can benefit from. Importantly, the focus on search as a primary entry point to collections is a major limitation for accessing cultural heritage material. The mimicking of web search engines can be considered rather harmful to the domain by barring it from other innovative access features distorting the view for exploring alternatives.

This dissertation promotes a new perspective on interactions and derives strategies for effective system design. For the first time, a framework for interactions was developed that allows institutions to assess their implemented interactions with regard to their ability to broaden access to digital material. The framework includes a metric that can help institutions qualitatively define their interactions, visualize them

in a radar graph and compare them to other systems. Therefore, this dissertation is an important contribution to the ongoing discussion on the purpose of interactions in cultural heritage information systems.

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Die Digitalisierung von kulturellen Gütern und der darausfolgende Online-Zugang zu ihnen hat dazu geführt, dass Gedächtnisinstitutionen wie Museen, Bibliotheken und Archive, neue Instrumente für Nutzer bereitstellen können mit denen das kulturelle Erbe erlebbar gemacht werden kann. Die meisten Institutionen haben die Chance wahrgenommen, zuvor unzugängliches Material der breiten Öffentlichkeit digitalisiert zur Verfügung zu stellen und stehen nun vor der Aufgabe, die kulturellen Artefakte möglichst facettenreich zu repräsentieren. Das Ziel ist es, ein enthusiastisches Publikum zu erreichen, das das kulturelle Erbe mit Hilfe des digitalen Mediums erleben, sich dadurch mit diesem identifizieren und zu seiner Erhaltung beitragen kann. Um das zu erreichen, wird meist ein digitales Surrogat der Artefakte in Webauftritten oder in Informationssystemen zur Schau gestellt. Das geht oft mit einem unwiederbringlichen Verlust von kontextueller Information einher, da die Objekte aus ihrem Zusammenhang, z.B. einer kuratierten Kollektion, gerissen werden. Idealerweise sollten digitale Objekte selbsterklärend sein und dem Nutzer eine Fülle von Interaktionsmöglichkeiten bieten. In der Praxis aber fehlt oft die Antwort auf die Frage, was zweckmäßige Interaktionen mit digitalen kulturellen Inhalten umfassen sollen und wie man diese am besten umsetzen kann.

Diese Dissertation beschreibt Interaktionen in kulturellen Informationssystemen und verbindet diese mit Zugangsmöglichkeiten zu digitalen Materialien. Basierend auf Fallstudien und dem Ansatz, Theorien aus empirischen Daten zu gewinnen (Grounded Theory), wurde ein theoretischer Rahmen entwickelt, mit dem man Interaktionen beschreiben und analysieren kann. Sieben miteinander verbundene Klassen bilden dafür die Grundlage. Diese beziehen sich entweder auf die Herkunft des digitalen Objektes, auf Nutzeraktivitäten, die auf die Kuration der Daten zielen, oder auf die Unterstützung der Bildung von Communities durch die Schaffung geeigneter Impulse für nachhaltige Nutzerbeiträge. Diese Kategorisierung ist dann um eine zweite Dimension erweitert worden, die die Entwicklungsstufe oder den Grad der Komplexität von Interaktionen in jeder Klasse bestimmt. Der Interaktionsgrad innerhalb der Klassen wird auf einer ordinalen Skala von *Grundlegende Funktionalität*, über *Organisation*, *Bereicherung* und *Kontextualisierung* bis *Kollaboration* dargestellt. *Grundlegende Funktionalität* bildet die Grundlage jeder Interaktionsgruppe. Mit steigender Komplexität erreicht jede

Interaktionklasse den nächst höheren Rang, idealerweise bis hin zu *Kollaboration*. Dieser höchste Rang zeichnet sich durch gemeinsame Nutzeraktivitäten aus, die in Gruppen durchgeführt werden. Der Zugang zu Information ist das Kernanliegen von Informationssystemen, weswegen die verschiedenen Formen des Zugangs - *Suche*, *Browsen* und *Beteiligen* - mit dieser zweiten Dimension verbunden werden. Komplexere Interaktionen gehen oft einher mit gemeinschaftlichen Aktivitäten, welche dann zu vermehrter Generierung von Zugangspunkten führen, die dann wiederum die Zugänglichkeit des Gesamtsystems verbessern.

Dieser Bewertungsrahmen für Interaktionen bietet einen ganzheitlichen Ansatz um Interaktionen und deren Zusammenspiel mit dem Informationszugang zu bestimmen. Dieser Zusammenhang hilft Gedächtnisinstitutionen zu verstehen, wie Entscheidungen im Design ihrer Informationsarchitektur den Umgang von Nutzern mit den präsentierten digitalen Artefakten beeinflussen. Somit liefert dieser Rahmen nicht nur ein geeignetes Vokabular um Interaktionen zu diskutieren und ihren Nutzen zu analysieren, sondern erlaubt auch einen visionären Ausblick, wie zielgerichtete Interaktionen weiterhin entwickelt werden sollten. Er zeigt also die momentane Situation, kann Systeme miteinander vergleichen und bietet Empfehlungen für die Entwicklung zukünftiger Interaktionen.

Der theoretische Rahmen wurde anschließend herangezogen um 72 kulturelle Informationssysteme in einer Inhaltsanalyse eingehender zu studieren. Die Systeme wurden nach ihren Charakteristika in verschiedenen Gruppen - *Museen*, *Bibliotheken*, *Archive*, *Aggregatoren*, *Kollektionen* und *Gemeinschaften* - eingeordnet, zwischen welchen Unterschiede und Gemeinsamkeiten aufgedeckt wurden, die es erlauben Zugang und Interaktionen in jedem einzelnen System besser zu verstehen. Beispielsweise zeigte diese Analyse, dass Museen ihren Nutzern mehr Möglichkeiten zur Partizipation, wie Nutzerkollektionen, bieten wollen, aber dabei oft die soziale Komponente vernachlässigen, was dazu fürht, dass die Features wenig genutzt werden. Museen können davon profitieren sich mehr auf kollaborative Aktivitäten zu konzentrieren, um nachhaltigere und dadurch mehr genutzte Interaktionen anbieten zu können.

Weiterhin wurde der theoretische Rahmen für eine tiefergehende Bewertung eines Systems aus jeder Gruppe genutzt um Empfehlungen für ein effektives Systemdesign zu erarbeiten. Dabei wurde besonderes Augenmerk auf den Einfluss von Interaktionen auf die verschiedenen Zugangsformen gelegt, mit dem Ziel, zweckgerichtete Interaktionen in Systemen anzubieten, von denen sowohl Nutzer als auch Institutionen profitieren können. Verschiedene Dimensionen - Inhalte, Zugang, Umgebung und Ziele - wurden analysiert und Empfehlungen aufgezeigt um diese Herausforderungen der Digitalisierung von kulturellen Artefakten zu meistern. So sollten Institutionen beispielsweise

gemeinschaftliche Aktivitäten anbieten, die die digitalen Inhalte erweitern und in ihrer Qualität verbessern, um die Beteiligung von Nutzern zu fördern. Je mehr Zusammenarbeit in den Aktivitäten realisiert wird, umso mehr Zugangspunkte werden auch für die Inhalte geschaffen. Diese zusätzlichen Zugangspunkte können dann von anderen Nutzer durch *Suchen*, *Browsen* und *Beteiligung* erfahrbar gemacht werden. Dies führt auch zur Bildung von aktiven Gemeinschaften, in denen Missbrauch Einhalt geboten wird und mehr Zugangspunkte geschaffen werden, von denen alle profitieren.

Die Dissertation leistet einen wichtigen Beitrag um nachhaltige Interaktionen in Informationssystemen des kulturellen Bereiches zu verstehen, zu bewerten und zu implementieren. Zum ersten Mal wurde ein Rahmen für Interaktionen entwickelt, der Institutionen erlaubt ihre implementierten Interaktionen dahin gehend zu bewerten, in welchem Maße sie Zugang zu digitalen Materialien schaffen. Es wurde eine Kenngröße entwickelt, die Institutionen hilft ihre Interaktionen qualitativ zu bestimmen, diese dann in einem Radargraph zu visualisieren und sie somit mit anderen Systemen vergleichen zu können. Damit bereichert und erweitert diese Dissertation die Debatte um zielgerichtete Interaktionen in kulturellen Informationssystemen und wie diese gestaltet werden können.

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Abbreviations

AAT Art & Architecture Thesaurus

CRM Conceptual Reference Model

DPLA Digital Public Library of America

EAD Encoded Archival Description

EDM Europeana Data Model

EU European Union

GLAM Galleries, Libraries, Archives & Museums

HCI Human-Computer Interaction

IR Information Retrieval

ICDL International Children's Digital Library

LAM Libraries, Archives & Museums

LOD Linked Open Data

MOMA Museum of Modern Art

NYPL New York Public Library

OCLC Online Computer Library Center

OPAC Online Public Access Catalog

SIGIR Special Interest Group Information Retrieval

UGC User-generated Content

VRA Visual Resources Association

WWW World Wide Web

XML Extended Markup Language

CHAPTER 1

Introduction

1.1. Digital Cultural Heritage between User Expectations and Institutional Goals

For centuries, cultural heritage institutions such as museums, libraries and archives have acted as guardians of the society's cultural memory, guiding visitors and researchers through historic and contemporary assets while explaining their significance and value. Through digitization of cultural heritage and online access to it, memory institutions have the opportunity to provide new instruments for engaging users with cultural heritage. The goal is to draw in an enthusiastic audience that appreciates the cultural material and interacts with it through the means of the digital medium. Recent technological developments enable organizations to reach a broad spectrum of people with different backgrounds via the World Wide Web (WWW). Technology further facilitates contextualization of cultural heritage artifacts in an unprecedented way, thus opening up new horizons in experiencing cultural heritage.

A large quantity of cultural heritage objects that lingers in storage rooms and dark cellars is inventoried in in-house database systems and described with domain-specific vocabulary. Unlocking the potential of this vast amount of material and making it accessible is the challenge memory institutions are currently facing. Most institutions have seized the opportunity to revive this hidden heritage by publishing and displaying a digital surrogate on a website or in a web-based information system. They seek meaningful presentations of their digitized cultural heritage data by displaying contextual information and allowing purposeful interactions.

But transferring context and significance of objects to a digital environment is not a trivial task. First, the metadata describing the objects was never meant for public retrieval. It is full of internal vocabulary and targeted toward simplifying the workflow of a particular institution. Second, the digital representations do not reflect the context the original artifacts were embedded in. This leads to a loss of meaningful information as established relationships such as the order of acquisition, affiliation to a particular collection, or experience of the responsible professional cannot be reflected online. When objects are ripped out of their original context, costly curated information may be lost forever. Thirdly, institutions often do not have an answer to the question what purposeful interactions with digital cultural heritage should entail. Beyond the wish to offer broadened access, there is not much understanding of user needs and requirements in cultural heritage information systems. This is challenging for institutions, as they do not know what type of services they should provide to their potentially heterogeneous audiences and what kind of interactions will prove to be successful in future. Furthermore, users expect access to material around the clock without bothering about institutional boundaries or access systems.

To solve this problem, several steps need to be taken. As a starting point, the information system in which the digital surrogates are stored needs to offer appropriate access functionalities that bring meaningful objects to the surface and ensure important information does not get buried in a sea of low quality metadata. Improving and broadening access to cultural material is the core concern of memory institutions that decide to digitize their material offering users permanent access to cultural information. Furthermore, the context of the original artifacts needs to be preserved in the digital environment. Ideally, digital artifacts should be self-explanatory, providing the user with several perspectives on how the artifact can be used and why it was included in the cultural canon. The last step is the provision of meaningful interactions that generate a sustained added value for the user. This thesis sets out to guide this needed development.

1.2. Interactions with Digital Cultural Heritage

Cultural heritage information systems need to be differentiated from systems accessing pure textual content or providing services for different domains. One of the main differences between a generic information system and one storing and accessing cultural heritage are the potential interactions with the digital content.

From the cultural heritage institution's point of view, interactions need to enable users to immerse themselves in the historic situation an object gained significance from and understand in which context it was created. In the best case, context and digital objects are so interwoven that they transport the user back in time, simulating the historic setting. The goal of memory institutions should be to present and showcase digital cultural heritage while striving to enthuse users about their content.

In a first step, access to the material needs to be provided. Following, context is the fuel that gives meaning to cultural material. In the digital presentation of this material, institutions need to preserve not only the artifact but also its context. On the one hand, there is the risk of ripping the cultural objects out of their context; on the other hand, if the context is preserved, the exposure to a heterogeneous audience online can add faceted viewpoints to the material in a way cultural institutions have never dreamed of. Participation should be one of the core components of any efforts that target interactions with and access to cultural heritage material ideally contextualizing the existing content. The potential of leveraging user engagement and interactions for recommending potentially valuable content to others is a relatively new method of providing users with interesting content. The extent to which user participation improves access to heritage material is another focus of this thesis.

For now, it is not clear how users should interact with the systems, browse through the content, find what they are looking for. Furthermore, there are no use cases these systems should be designed for. It can only be speculated what a user's idea of an engaging online cultural experience could be. Research has shown that the general public theoretically considers the interactive activities provided by the institutions very interesting, but in practice, these features are hardly used (e.g. Fantoni, 2006; Marty, 2011). When it comes to predicting potential interactions with digital cultural heritage, institutions and users are groping in the dark. Generally, institutions try to emulate the physical experience online or provide activities they think users would like to do, such as creating exhibitions themselves. The real potential of the digital medium remains unexploited and asking users what type of activity they would prefer and expect is often not fruitful. Murray supports this view: *"users cannot tell us how to resolve problems that require new design strategies"* (Murray, 2011, p. 6). It is essential to identify the potential benefits of displaying and providing cultural heritage in a digital medium that offers unique affordances enabling different interactions than those commonly practiced with physical ob-

jects (Murray, 2011). For example, museums can exploit the advantages of an online display through deep-zoom functionalities that enlarge details of the artifact. In general, the provision of access to new and existing audiences is one goal in the development of information systems for cultural heritage. Defining purposeful interactions with cultural heritage online and giving users guidance to explore new functionalities in experiencing digital artifacts are certainly some of the most important aspects memory institutions should take into account.

Presently, most of the cultural heritage information systems are similar to an Online Public Access Catalog (OPAC) in a library that offers proof of availability and provenance of a certain book. Search is the most common form of access in online information systems but not very helpful if you do not know what to expect in the system and have problems to formulate a query in an unfamiliar domain. Supporting users in accessing material should be the foremost concern of cultural heritage institutions. It should not be underestimated that the characteristics of the content shape its use. Most memory institutions have primary resources (or substitutes of these primary resources) that are especially interesting for researchers in the humanities, but they may also serve as a resource for educating the general public. All these target groups are very different from each other, expecting different resources, pursuing different goals and having a different set of retrieval skills.

Memory institutions literally rave about the possibilities technologies offer for their domain. From augmented reality to deep-zoom functionalities that let users see every brushstroke in paintings, the opportunities are immense and the future looks bright. Before we can explore what technology has to offer and how this can be used to benefit users and institutions alike, a baseline of prevailing interactions in this domain needs to be identified in order to demonstrate which of the designed interactions are useful and which are not.

1.3. Research Questions

In the last few decades, memory institutions have experienced a shift from analog access to providing access to their content through digital means. This process is characterized by the digitization of analog material on the one side and the access to physical objects via their metadata on the other. This thesis deals with the results of digitization, the digital objects, and how users can interact with them while supporting the institutional goal to broaden access. In this thesis, the interactions with digital cultural material are the focus of research. Information systems in this do-

main should take the characteristics of the cultural material into account and need to be able to match their goals to user expectations and needs. The system provides certain interactions that shape and form the access modes users can utilize. This thesis will link different types of access with user interactions and will show how these correlate.

Bridging the gap between user interactions on the one hand and access to content on the other will lead to better purposeful interactions that support the effort of institutions to provide universal access to cultural material. To do this, it is central to have a clear understanding of what information access means for cultural heritage information systems. Different information access functionalities must be defined for this content and a relationship between interactions and access needs to be established. Therefore, the first goal of this thesis is to describe the interactions prevailing in cultural heritage information systems and link them to the access functionalities provided for this material. Often, cultural heritage institutions fall back on access functionalities and solutions adapted from information systems in other domains that are not appropriate for accessing cultural content. The question of what access in cultural heritage information systems means and how it can be broadened and improved is central in this research.
This thesis aims at answering the following research questions:

1. RQ1: How can user interactions in cultural heritage information systems be characterized and how do interactions relate to access to cultural material?

2. RQ2: Do information systems from different types of cultural heritage institutions offer different interactions? If yes, what characterizes each of them?

3. RQ3: How can the evaluation of user interactions inform effective system design?

In order to better understand interactions and access functionalities, a framework is developed, which offers a vocabulary to describe interactions in cultural heritage information systems and how they relate to different access modes. The goal is to establish a theoretical background that allows the evaluation and discussion of interactions in the digital cultural heritage domain. Additionally, this thesis will show how information systems with cultural heritage material can benefit from collaboration patterns that enable the institutions to leverage user-contributed material. Not only is this a nice-to-have feature but an essential engagement tool that can

help to improve metadata and contextualize the cultural heritage material. Coupling this with Linked Open Data (LOD) standards allows memory institutions to accumulate user-generated data across platforms and build a cross-national digital cultural memory. The evaluation of interactions will help to determine the situation of cultural institutions and their online offerings, enabling the assessment of the system's ability to present cultural material and engage users in meaningful interactions. The final aim of this thesis is to derive guidelines and recommendations for the implementation of purposeful interactions in the cultural domain.

Based on a review of 50 cultural heritage information systems, a framework for interactions in the field is established. The framework clusters domain-specific interactions and pairs them with their level of implementation. Additionally, the framework can give an insight into the relationship between the interactions and the access functionalities provided by the system and therefore contributes to answer research questions one. It presents a metric that can help institutions qualitatively define differences between their systems and others.

Following, an extended dataset (72 systems) is created to establish an overview of the existing interactions in current information systems in the cultural heritage domain. With a content analysis, interactions in museum, archive, library, aggregator, collection and community systems are described and characteristic differences between these system groups are listed answering research question two.

To evaluate interactions of systems, one information system per institutional group is analyzed and recommendations for an implementation of purposeful interactions were given. Results of the analysis provide information to develop an effect system design strategy and answer research questions three.

1.4. Organization of Dissertation

The dissertation is organized as follows: Chapter 2 defines cultural heritage information systems. It also focuses on the three main institutions developing such systems, namely libraries, archives and museums. The challenges these institutions are facing when offering their content in a digital environment are the focus of this chapter.

Chapter 3 defines interactions and examines their relation to information access. The three main access points, *Search*, *Browse* and *Engage* are introduced.

The methodology for the research presented in this thesis is introduced and discussed in chapter 4.

Chapter 5 describes and explains the framework derived for analyzing interactions in cultural heritage information systems.

Chapter 6 analyzes the interactions in six different groups of cultural heritage information systems mapping their interactions to the framework. Groups are compared with each other to derive characteristics and certain system design patterns.

In chapter 7, the framework is used to provide an in-depth analysis of one system per group which results in recommendations how to implement purposeful interactions benefitting users and institutions alike. The chapter will also summarize the findings, leading to a strategy for effective system design in the domain of cultural heritage.

Conclusions, the contribution of this thesis and an outlook on future work will be given in chapter 8.

CHAPTER 2

Cultural Heritage Information Systems

Memory institutions are becoming increasingly concerned with providing universal access to their collections and objects. Looking at the development of cultural heritage institutions, Freedman (2000) notes that they move from being gatekeepers to becoming facilitators and mediators of knowledge exchange. He further states that in the 19th century, museums and other cultural organizations were authority institutions exhibiting rare and distinct objects. They were telling stories about distant cultures and presented artifacts explorers had collected in remote areas. They had the key to objects that would not have been accessible to the public otherwise. The pure possession of these objects conveyed a certain amount of power. The 20th century brought the possibility for the general public to travel to far-away places and the ability to take photos and document cultural heritage in their private sphere. The rise of new distribution media such as radio and TV opened up possibilities for the public to experience cultural heritage outside of the museum or other cultural institutions. Despite the fact that the museum still possessed the objects and maintained access to them, coupled with the authority to interpret these objects in the context of their collection history, access was widened and the role of memory institutions shifted (Freedman, 2000).

Triggered by the digital revolution, cultural heritage institutions usher in a new era. They digitize their content and its metadata representations and make it accessible in information systems. Digital surrogates and their metadata complement cultural artifacts and extend their value to the digital world where they can be accessed remotely. Information about them is now easily retrievable online and visiting a physical exhibition is not the only way to experience cultural heritage.

With remote access, cultural heritage institutions lose their monopoly on interpreting the material; now everyone can interpret cultural heritage and add different view points to it.

Cultural institutions need to determine how they can provide interpretation and guidance to support users in interacting with digital cultural artifacts. A strategy for handling digital content is required. Therefore, cultural heritage information systems need to be designed carefully with the aim of providing novel and innovative ways to engage with cultural heritage outside physical institutions while supporting new interactions and usage patterns.

This chapter gives a definition of cultural heritage information systems and explains their usage. Additionally, it highlights the challenges the three dominant cultural heritage institutions - libraries, archives and museums - are facing with regard to making their digital content accessible in cultural heritage information systems.

2.1. Defining Cultural Heritage Information Systems

In contrast to natural heritage, cultural heritage consists of objects created or interpreted by humans. These objects are products that inherit a purpose and are defined by their use (Bearman & Trant, 2002). This definition will explicitly be extended to include intangible objects such as dances or music. Cultural heritage is stored, maintained and preserved in memory institutions such as libraries, archives and museums, often referred to as LAM[1].

A cultural heritage object can be a physical entity and its analog or digitized surrogate, but it also encompasses born-digital material such as websites, Twitter feeds or social network profiles. It is conceivable that digital surrogates become independent and self-contained records when they get enriched online with LOD or user-generated content. The main responsibility of cultural institutions is to extend their mandate and cope with the challenges raised by maintenance and preservation of collection that have analog and digital material. This is even more relevant if Clifford Lynch's claim proves true that each memory organization will be obliged to provide a digital representation of a special collection artifact (Lynch, 2009).

Information systems that store and display digital cultural heritage are defined as cultural heritage information systems. This relatively young term is used for

[1] Another commonly accepted acronym is GLAM, which stands for galleries, libraries, archives and museums.

information systems that *"collect, store, organize, search and display cultural heritage objects or their (metadata) representations in a digital environment"* (Petras et al., 2013, p. 144). The term cultural heritage information system embodies a multitude of other concepts that refer to similar information systems such as digital libraries, archival, museum or cultural heritage portals. Throughout this thesis, the term cultural heritage information system is used to refer to information systems that store digital cultural heritage and make it accessible in different ways.

Cultural heritage information systems need to answer questions of *"who, where, why, how, when; and what was created, collected, discovered, described, published, and exhibited"* (Bearman & Trant, 2002, p. 4). Providing answers or the means to derive these answers enables users to learn, gain knowledge and contextualize cultural information. Traditionally, cultural heritage institutions create room for interpretation. It is a challenge to transfer this mandate to a digital environment. It requires analysis of the different facets that reflect the scope of interpretation each institution inherits. Translating these facets and making them transparent online are crucial challenges cultural heritage information systems need to handle. Additionally, cultural heritage information systems need to provide interactions that go beyond the common search box and accommodate contextualization and collaboration. A prerequisite for interactions and facilitation of use is the transparency of the scope and extent of the cultural collections provided.

Most cultural heritage information systems are hosted at or originate from one of the main memory institutions - museums, archives and libraries. Each of them has a distinct way of organizing, documenting and presenting the material. They do not only differ in their mission and their development, but they serve different purposes and try to fulfill different goals. They tend to be grouped under the term memory organizations as they are all designed to preserve our collective cultural heritage. But their roots are different, and this is reflected in the way they store, organize and present their collections. These differences have many implications for the challenges the different institutions face when going online or making their metadata accessible via a cultural heritage information system. This also influences the engagement and participation strategy of these different institutions.

Following, the characteristics of the three main memory institutions will be identified, describing the effects of digitally representing their holdings.

2.2. Libraries

Libraries provide access to resources and services for research, teaching and learning purposes. Their core tasks can be subsumed under technical services (acquiring, cataloging and maintaining the material), public services (reference services), and management (marketing and budgeting) (Arns, 2009). Libraries are concerned with the *"collection, organisation, storage, retrieval and mediation of literature and documents"* (Hjørland, 2000, p. 29). Being around for centuries, libraries' foremost goal is to collect published information in every form and make it accessible while preserving it for future generations. They pursue their mandate to educate the public or certain groups by increasing their information literacy. This includes access to information as well as tools and strategies to retrieve information and to make sense of it.

Compared to other memory institutions, libraries quickly embraced the technological change and its possibilities. Due to the nature of the material libraries are holding, the shift to the digital era was carried out earlier than in museums and archives. The information they provide is independent from the medium it is stored on, and therefore the content is more important than the medium itself.[2] This characteristic makes it easy to represent book content in an online environment, as books do not need much contextual information to prove their significance and value. They normally speak for themselves. Consequently, the task and function of a librarian is not to interpret the information in books (Buckland, 1991, p. 113), but rather to interpret the information need of the users and consequently pointing them to the right book. The transition to the digital environment was similarly hard for libraries at the time as it is for archives and museums now. The consequences for the technological change were intensively discussed, for example mapping the information seeking behavior to the technology and offering systems that support browsing and exploration (Bates, 1986). Especially interesting is the project HYPERCATalog, which presents a concept of an online catalog that anticipates developments of the library catalog automation (Hjerppe, 1986). Hjerppe (1986), for example, suggest user notes that can be expressed in comments or links. This visionary approach offers similarities to discussions and future scenarios on the design and composition of museum and archive systems.

[2] Nevertheless, there are cases when the medium itself needs to be preserved and carries the cultural heritage information and can therefore be compared to museum collections (Buckland, 1991, p. 34), e.g. books marking a milestone in book history like the Gutenberg Bible. In these cases, preservation might constrain accessibility.

2.2.1. Libraries as Trailblazers for Remote Access

For most library material, the primary interaction is use through physical handling. In the case of a book, this means reading, flipping pages or browsing the index. Aspects of preservation limit the permitted use by prohibiting to write into books or to bookmark them by giving pages dog-ears. Within these cultural boundaries, the public can use books in a library according to their intended use. This is contrary to a museum where users experience the objects without using them. Instead, curators design exhibitions to provide the context so that the users can envision how the object might be used.

Libraries and their preservation mandate benefit from the mass digitization of books. Reduced to their content, books cannot lose their authenticity, as the words will be the same in the book as well as in its digitized version. Books are easily adaptable for online consumption as their content, often text, can be read online and is easily transformed to the medium it is accessed on. These characteristics of the material helped libraries to embrace the benefits of technology at an early stage. They were the first of the cultural heritage institutions to transition their material and its metadata into the digital environment. In this transition, several stages can be observed[3]:

1. 1960, early 1970s: organization, retrieval, documentation and maintenance are done by experts (Tedd, 1994).

2. Public access is provided with restrictions to certain materials due to preservation reasons. A record or surrogate of the object refers to the proper location of the book. When providing access through metadata, the actual order of the physical objects in their storage space does not matter anymore. It is not relevant whether all books are sorted by author or by the date of entering the collection as long as the notation is known and the placeholder, e.g. an index card in libraries, notes the physical space of the object.

3. Late 1970, early 1980: the OPAC is born (Tedd, 1994); classification systems are transitioned online. Access for non-experts is broadened but retrieval success is based on understanding OPAC rules and retrieval languages.

4. Library material gets digitized, classifications become less and less important. Lay people can access more material through full-text search, while experts

[3] Dates relate to the development of OPACs mainly in the US.

still manage the content. The shift to use more digital media results in an adaptation of library services that can be used online (Arns, 2009). Online use presents a clear advantage, as numerous uses of a digitized book do not leave any traces.

5. User-generated content enriches digitized material such as metadata and integrated other Web 2.0[4] features such as blogs and instant messages (Kumar, 2013). Retrieval is text-based but documents are more and more enriched with contextual information. Documents will be embedded into a broader context that goes beyond simple search (Johnson & Craven, 2010). Discovery is simplified through contextual interlinking and true semantic search might be the future (Cahill, 2009, p.189).

2.2.2. Interactions with Digital Library Material

Information access in libraries focuses on presenting the OPAC, with an increasing amount of institutions starting to integrate it with other information offerings. Research about use and usability of library information systems often focuses on features within the OPAC (Mi & Weng, 2008) and search strategies of users looking for items in the catalog (e.g. Johnson & Craven, 2010). Some researchers outlined the benefits of advanced features such as user-created folksonomies to organize information in catalogs and build online communities (Spiteri, 2006); others looked at the opportunities for libraries to develop their catalogs into collaborative tools that tolerate user-generated content and social components (Tarulli & Spiteri, 2012).

Several aspects characterize access to digital library material. These aspects shape the challenges libraries are facing when offering digital material and online services:

Tradition of remote access to material: Due to the characteristics of their material, libraries have overcome some of the challenges of online access at an earlier stage than museums and archives. Compared to other heritage institutions, libraries look back on a long tradition of remote access to library material or its metadata. This transition was not easy and was firing a heated controversy and debate on how to overcome these challenges. On the other hand,

[4]The term Web 2.0 is often attributed to Tim O'Reilly and presents a set of principles that describe the architecture of the web and the way people use it. The principles are for example "harnessing the collective intelligence and collaboration of users to create content" (O'Reilly, 2005). Similarly, the term "social software" is used that inherits the principles of Web 2.0. Farkas (2007) defines it as a tool that allows people to collaborate and communicate while facilitating syndication [p. 1].

library material can be easily described and retrieved as most of the information needs can be expressed with known-item searches or through subject access. Furthermore, libraries have a long tradition to maintain and encourage subject access. Defining new uses and services that adapt to the increased expectations of users to access all information immediately while supporting the sense-making process will be a challenge for libraries.

Focus on content: Library material is not unique and in most cases the text is more important than the object or book this text is in. Each of these books is interchangeable with the exact copy of the same book without loosing its authenticity (Buckland, 1991, p. 34).

Competition from other information offerings: Libraries struggle to compete with the information offerings of other information systems online and the web in general, fearing to lose their relevance. Some strong voices argued that the unlimited accessibility of information on the Internet makes libraries superfluous and that their services could be easily reproduced by other Internet services, especially if librarians miss out on trends (Sullivan, 2011). Library research argues against this and is trying to find solutions to the problem of users who are rather turning to search engines for their information needs than to their library (e.g. S. Jones, 2002; Chad & Miller, 2005). The solution for many libraries is the provision of more user engagement within library catalogs. A desired feature is to merge with other information offerings and to blend into different services patrons use to retrieve the right information (Calhoun, 2006, p. 38). Other proposals debate personalized spaces for patrons who get information based on the profile they created and the customized settings they have chosen (Gibbons, 2003). Welcoming Web 2.0 functionalities to build collaborative spaces and form communities is expected to be the future direction for libraries in the online world. Tarulli and Spiteri (2012) argue that the goal of library catalog development is to reach users irrespective of their location and device. Cahill postulates that it is the users that will determine the direction of the library evolution and that this process is the key to maintaining relevance (Cahill, 2009, p. 42).

Libraries can be considered early adopters of technology enabling remote access to their material. But this technological change has also forced libraries to defend their funding and existence. The majority of people are looking for information on

the Internet; it is just natural for libraries to expand their services in this information space, and they will need to expand more in this direction to stay relevant.

More and more OPACs allow users to interact with the objects they are representing. They allow the users to tag, comment and favor OPAC items (Griffis & Ford, 2009). In addition to providing an interactive online experience, representations get contextualized, thus offering more room for different views and interpretations. One can argue that interactions with a digital library object increase its likelihood to be retrieved more often through user comments, sharing and annotations. Letting users participate more can also ensure that vocabularies stay up-to-date and information is described from different perspectives.[5] Expanding these features and embedding them into traditional library services online will be of increasing importance for libraries in the coming years.

2.3. Archives

Archives and their practices play a special role in cultural heritage preservation and records management due to their characteristics and the type of records they maintain. Their task is to preserve documents and objects that were produced by human activity (International Council on Archives, 2009) and the administration and preservation of records a given institution is constituted of (Cunningham, 2009).

Archival material is preserved to record the authentic situation in which it was produced. Therefore, the most important requirement of an archive is to sustain the original context of the material including the chronological order in which documents were created (Buckland, 1991, p. 33). Archival material should not be altered in any way to guarantee that the original context can be reconstructed. Archival collections are primary resources that draw a picture of a certain event in history through the lens of the document's creator; they are witnesses of past events not altered by subsequent forms of interpretation. This makes archival material valuable sources for historians (Pitti, 1999). They rely on archives to ensure that the material is unfiltered and free of alteration or interpretation (Buckland, 1991, p. 33); any changes to this dogma need to be visible and transparent. Historians build their theories by interpreting the primary sources and relating them to knowledge that

[5] Although libraries endeavor to represent the universal knowledge in their classification and organization of information, it is clear that all these organizational principles have a cultural bias tending to describe things from the perspective of the vocabulary used in times when the classification was created. This leads to exclusion and decreases the access to information (Olson, 2001).

was gathered after the documents were created thus connecting them to a greater context. Museums in contrast to archives interpret and contextualize objects based on the present knowledge and are driven by an educational agenda. Museum objects gain significance and get interpreted by being part of a certain collection and being chosen by a curator; archival material on the other hand is assumed to be significant for society by default as it is preserved for reconstructing past events in the future.

2.3.1. Finding Aids

Archival records are traditionally indexed and made accessible via finding aids. These are highly complex and structured documents that are hierarchically designed. Archival material is rarely indexed on the item level. Archives rather make a particular document accessible via the next higher level, which can be either the folder or the box the document is stored in. Hundreds or even thousands of documents might be accessed via one heading (entry point) with no granular level of indexing. Locating a document becomes time-consuming and tedious as it generally requires expert knowledge of an archivist. The use of specialist vocabulary in finding aids targeted towards archivists is an additional boundary for the novice user trying to find the desired material (Kim, 2004). Due to these constraints, the archivists are the mediators between the users' information needs and the localization of material (Cruikshank et al., 2005); they need to assist in finding the appropriate box (I. G. Anderson, 2004) in which the right document might be stored.

Online access to archival material is realized through two main approaches: digitizing the finding aid or digitizing all entities of the archival records. The archival practice of describing aggregations of objects rather than individual items results in an access problem when the archival records are digitized on item level - they are missing metadata. For now, the digitization of the finding aid is more common and its flaws in providing access to material online are revealed. I. G. Anderson (2004) points out that many think the *"print paradigm of archival finding aids will translate into the digital age with relatively little modification"* (I. G. Anderson, 2004, p. 83), neglecting the fact that online requirements should result in an adaptation or even an improvement of the finding aids.

Motivated by the public's demand to access cultural heritage material remotely, the question of the usability of online finding aids and retrievability in digital archives becomes more pressing. Most of the discussion concentrates on how users navigate finding aids and how these can be improved (e.g. Chapman, 2010; Cruik-

shank et al., 2005; Nimer & Daines, 2008). Studies revealed that finding aids are generally hard to use, and without thorough documentation often the assistance of an archivist is necessary (Duff & Stoyanova, 1998; Yakel, 2004). Prom (2004) points out that they are so hard to work with that they will keep people from using them unless they are highly committed. The development of archival metadata standards for publishing in the WWW such as Encoded Archival Description (EAD)[6] fuels the discussions that archival descriptive systems fail to provide access to the material they are describing. A content analysis of six archival repositories using EAD finding aids revealed that there is a lack of search and browsing functionality to efficiently navigate the resources (Kim, 2004). An often-expressed concern is that archivists do not understand the information needs of their clients (Dowler, 1988). Cox (2008) argues that finding aids are not adapted to the way researchers work. He summarizes different user studies dealing with the information-seeking behavior of researchers and their archival practices. Most of the studies claim that archival finding aids do not reflect the needs of researchers and that there is a considerable gap between the expectations and practices of researchers on how to find primary resources and the construction of finding aids (e.g. I. G. Anderson, 2004). Furthermore, Light and Hyry (2002) argue that finding aids in general lack objectiveness as they can only represent one viewpoint (the one of the creators or their institution) and that this subjectivity is not transparent in the finding aid. They suggest the use of colophons to express the archivist's influence on the finding aid and the collection. Additionally, annotations by researchers ensure that different viewpoints on the collection are aggregated and stored for future reference (Light & Hyry, 2002).

2.3.2. Interactions with Digital Archival Material

In contrast to the other memory institutions, archives are at the beginning of thinking about user interactions and engagement with their material. One reason for this is that their material is rarely fully digitized as it consists of several thousands of single page documents often only interesting for a niche audience. Their material is unique and interrelated, described by metadata that tries to capture structure and reflect the content at the same time (Pitti, 1999). Designing digital interactions for this material is challenging and the problem is aggravated by the limitations of digital finding aids.

[6] EAD - Encoded archival description is a XML-metadata standard for archives maintained by the Library of Congress (http://www.loc.gov/ead/, last accessed November 20, 2013).

Similar to libraries, research on archive information systems focuses on discovery tools and digital finding aids (Duff & Johnson, 2002). Often this goes along with the question how useful Web 2.0 functionalities are for the use of archival finding aids, e.g. social tagging (Chen et al., 2008). Others are looking at the future of archives and how the public will use them. A participatory archive is envisioned that focuses on the users and provides archival data for re-use (Palmer, 2009). Huvila (2008) proposes an archive where users actively contribute in form of comments, descriptions and translations. Yakel et al. (2007) describes four social features that should be part of archival systems, namely commenting, collaborative filtering, bookmarking and visitor awareness.

Providing online access and interactions with archival material, archives need to take several aspects into account:

Context: The context is the archive's most valuable asset, as it gives each documents its meaning (Theimer, 2012). There is a danger of losing context online, especially when only the finding aids are digitized. If the documents are digitized, they must be contextualized by either keeping their initial archival order or by interlinking. Both methods are hard to implement and error-prone when automated.

Display of finding aids: Too often, the structure of the Extended Markup Language (XML) standard is the driving force behind display option for finding aids (Chapman, 2010). As finding aids are very complex and built in a hierarchical manner, they need to be displayed in a user-friendly way. In a study users expressed the need to be aware on which level they are navigating at all times (Altman & Nemmers, 2001). Additionally, retrieval on item level is wished for, i.e descriptions of individual pages or papers should be the focus of developments in this area (Altman & Nemmers, 2001).

Retrievability: The underlying data structure of archival finding aids and other metadata is not designed for web retrieval. As archives lack metadata on the document level, they cannot benefit from the advantages text retrieval might offer, e.g. creator search. Even if this metadata was available, some of these facts might be hidden on a deeper level of the document making full-text search of the whole document desirable. This is for example the case for birth certificates or other similar administrative lists which contain personal names of potential interest in every line.

Vocabulary: The highly specialized archival vocabulary is not easy to understand by the public. A study suggests that vocabulary used in finding aids does not match with the users' commonly understood terms (Kim, 2004).

Target audience: Another concern is that research on online finding aids primarily deals with historians and humanists and their information-seeking behavior. Prom (2004) states that they are only used by archive or computer experts. Much less is published on the public using the archive through online finding aids. And the general practice of one on one support will not be feasible if archives get so popular that they are used beyond research.

Online presentation and search of archival material is not a trivial task. The main concern here is the archival practice of organizing the material in boxes with no item level description. This is aggravated by the hard effort to use finding aids and their orientation towards expert users.

2.4. Museums

A recent essay attributes one essential characteristic to the museum that differentiates it from any other institution: the exhibition in a physical environment (Dillenburg, 2011). That explicitly excludes online museums or digital libraries with museum content and museum websites with virtual exhibitions. Nevertheless, they are usually the first encounter users have with a particular museum. They can be seen as supplements to the offerings of a physical institution and are gaining more and more importance by showcasing the highlights of a museum and engaging visitors before and after the visit. The definition of a museum states that it is a *"non-profit, permanent institution [...] open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment"* (International Council of Museums, 2007). Museums in contrast to libraries have artifacts that can be considered to be unique (Marty, 2008b). This is also true for archival material, but for museum objects, their singularity is inherited through the interpreted meaning that is preserved. Some museums might have the same objects, but they will never carry the same sense of meaning, as the objects were acquired in different settings and probably owned by different people, which results in a different history. Therefore, museums are especially challenged when presenting their artifacts online, as without their interpreted meaning the significance of a museum

artifact is not apparent.

The goal of museums is to interpret the cultural heritage with a view to the museum's collection strategy. Where archives have only a limited choice, which documents to preserve (Buckland, 1991, p. 33), the museum already interprets its artifacts through its acquisition strategy. The curator selects parts of the museum's holdings for exhibition, interpreting and contextualizing the material further - *"an exhibition is a display with interpretation"* (Burcaw, 1997, p.129). Depending on the theme or topic, museums do not need to display the actual unique artifact but can choose to show a surrogate. For example, natural history museums display wildlife behind glass with stuffed animals or plastic surrogates. Next to these surrogates of certain specimen, museums also keep objects of art and artifacts (objects worth studying) (Bates, 2007a). In many cases, the meaning of an object can be transferred to its copy without losing much of its entertainment and educational value, but not without losing its significance for serious scientific studies.

Museums and their commitment to unique interpretations of their artifacts face difficulties as to what kind of information the museum representation should carry. As Marty (2008b) points out, the uniqueness of the artifacts adds the burden of describing and documenting to the museum owning them. There is no shared database they can retrieve this information from other museums as for example in libraries (Marty, 2008b). So museums came up with their own local solutions for schemata and controlled vocabularies adapted to their needs. This obviously poses a problem when aggregating metadata from different museums into one database. Several attempts were made to create standards for controlled vocabulary that are valid across museums (e.g. Marty, 2008b; Bearman, 2008). Examples are the Getty vocabularies such as the Art & Architecture Thesaurus (AAT), data content standards by the Visual Resources Association (VRA) and other efforts to standardize electronic collections management with SPECTRUM (Marty, 2008b). Nonetheless, only large institutions adapt these efforts, as smaller ones are dependent on volunteers with less domain knowledge. This produces heterogeneity in describing the objects, which is reflected in the museum systems online. Overcoming these different approaches is one of the main challenges for offering access and engagement with digital museum content.

2.4.1. Transferring Meaning to an Online Environment

The challenge for museums in representing their information and knowledge is to find the balance between *"represent[ing] both the thing and the knowledge of the thing"* (Bearman, 2008, p. 37). To serve several user groups, it is important to create *"interpretative, educational information resources"* (Marty, 2008b, p. 31). Digital information representations as found in typical cultural heritage information systems fail at this, and most collection management systems are also weak in this regard. They are often not able to preserve the initial meaning that was attached to the described object. This is mainly due to the fact that information representation in museums was rarely intended to act as a surrogate for the artifact. Another reason is that the problem of knowledge organization in museums was never approached with the mindset of storing meaning or interpretations. Storing surrogates of museum objects started in an object-centered way (Bearman, 2008). Bearman (2008) further points out that data models were constructed to store an object with its metadata and museum specific data such as an acquisition number. They were proof of existence rather than a documentation of meaning and knowledge. These early systems where not built to transfer knowledge or deliver contextual information about the object. They were quickly followed by process-centered data management systems (Bearman, 2008), which focused on the work flows inherent in museums.

A successful museum representation entails surrogates that address different user needs so they can access the representation of the artifact instead of the original object (Marty, 2008b). Museum information systems are still built in such a way that the availability of a museum object can be looked up but the real value and meaning of the object can only be understood by consulting the physical object within its collection (Marty, 2008b). One reason for this is the nature of museum objects that makes them difficult to be presented online. There is the challenge of digitization of mostly 3-dimensional objects that can result in much of the object's significance being lost when the surrogate is a thumbnail and only a metadata representation. In this context, it is interesting to note - and this is an important difference to other cultural heritage institutions such as libraries and archives - that the digital information representation for museum objects is a picture. Even if the significance of the object lies in a textual message it conveys or the sound it makes, the visual aspect is crucial. An exception here is intangible cultural heritage, e.g. a speech by Martin Luther King that is well represented with more layers of information such as in a video.

2.4.2. Interactions with Digital Museum Material

Museums are changing: they become platforms for engaging with cultural heritage. Weil (1999) argues that museums moved from looking after their collection and studying them to becoming a place oriented to serve the public. With the rise of the World Wide Web, museum information systems became the representations of the museum online enhancing the institution's activities with additional information, interactivity and virtual tours (Sarraf, 1999). Websites were created to complement the museum visit and encourage a cyclic approach where the website supports the goals and experiences of a museum visit on the one hand and prepares for a visit on the other (Marty, 2007). Museum websites as online representations of the physical institutions were expanded by access to collection information and information residing in collection management systems (K. B. Jones, 2007).

There is a lack of knowledge of what users actually expect from museums and especially their online presence. Paul Marty points out that users expect museums to be like digital libraries providing access to museum resources around the clock (Marty, 2008c, 2008a). He further stresses that museum websites should support tasks users want to do online with their web presence, but acknowledges that user needs are not defined enough and should be the focus of future research.

Although visits to museum websites are significantly higher than to the physical institutions, motivations for visiting museum websites are not well understood (Ellenbogen et al., 2008; Fantoni et al., 2012). An online survey conducted on several museum websites revealed five motivational factors for users to visit a museum online (Goldman & Schaller, 2004):

- Planning a trip to the museum,
- Searching for specific information,
- Browsing and exploring for getting entertained,
- Research-driven due to an assignment, and
- Self-motivated research.

Fantoni et al. (2012) followed up on this research by investigating the motivations of visitors coming to the Indianapolis Museum of Art[7]. Fifty percent of the survey respondents claimed that an upcoming visit is the motivation for their online visit

[7] http://www.imamuseum.org/ last accessed September 11, 2013.

and often these users go to pages that help them plan their time in the museum. In contrast, users coming to the site to find information for professional reasons are more likely to engage with the artifacts in the information system, searching the collection and exploring exhibitions (Fantoni et al., 2012).

It can be assumed that users lack imagination when it comes to future engagements with digital cultural heritage. But also experts struggle to envision future use of digital museum resources. Most of the museums do not know what purposeful interactions with their digital cultural heritage objects could entail and how online content can be designed (Peacock, 2007). In general, digitization is justified with the broader public access it offers. Often that means publishing the content of the museum collection management system. These systems are rarely adapted to public use, as they are full of specialized vocabulary and targeted towards expert search. In most cases, full-text search is provided, neglecting the information seeking behavior of the potentially diverse user groups of digital heritage artifacts. Specially developed tools are needed that are targeted towards the needs of different user groups (Booth, 1998).

Pruulmann-Vengerfeldt and Aljas (2009) assume that there is a gap between the skills and expectations of professionals designing systems for digital cultural heritage and the ones of lay people using them. The authors see the understanding of user motivations in engaging with the material as crucial to offer interactions that are useable and useful. For example, Amin et al. (2008) state that information seeking tools for cultural heritage experts mainly support fact-finding and simple look-ups and not the sophisticated information gathering practiced by these experts. Skov and Ingwersen (2008) find that users of museum information systems come with very different information needs, and their behavior differs from experts or professional information seeking behavior.

Identifying user needs and requirements is aggravated by users who might have no idea what to do with digital museum resources and a mismatch between what users say they want to do and what they are actually doing.[8] When asked, they often transport experiences from other portals, requesting features they know rather than ones that might be useful in this particular context. For example, a focus group study of Europeana revealed that users expect more contemporary media and more audiovisual content like videos (Dobreva et al., 2010). However, museum websites

[8] It is a well-known fact in usability and interface design that there is a big gap between user's assumptions of what they might do and what they are actually doing (Nielsen, 2001).

cannot and should not compete with Youtube[9] or similar platforms; they need to find a unique way to transport the value of their content to the user.

There is intensive research on the possibilities of personalization online and on-site in the museum domain. Ardissono et al. (2012) point out that physical visits to a museum can be considered a group experience, whereas the personalized website is focused on creating individual paths. They see a trend going toward the creation of virtual communities. Museums are generally aware of the potential of user engagement allowing them to share their thoughts and perspectives on museum material. Implementing collaborative technologies can satisfy user expectations and benefit institutional goals alike (Ellis & Kelly, 2007). Theoretically, the advantages of participative technology are plausible but in practical terms many obstacles delay further implementation. For example, a study with a sub-collection of the Cambridge Museum of Anthropology and Archaeology[10] showed that these technologies might not be as beneficial when offered without additional contextualization means. Often, users could not make sense of the object represented in a catalog record and had therefore no interest to add tags or comments to it (Srinivasan, Boast, Becvar, & Furner, 2009). Srinivasan, Boast, Furner, and Becvar (2009) stretch this argument even further by stating that these technologies need to change the documentation practice in museums and shift it to a practice that embeds multiple and even contradictory perspectives. The authors wish for participatory cataloging that will replace the paradigm of museum objects with just one primary identity.

With regard to interactions with digital museum material, the following aspects characterize museums and shape their path to become knowledge platforms:

Changing roles: With the challenges arising from offering online access to museum holdings, the role of museums is changing too. Their role is currently shifting from being the gatekeepers of heritage objects to becoming facilitators of knowledge sharing and exchange (Freedman, 2000). Every major museum has a wide-open window allowing potential visitors to take a peek at its collections and offerings before actually going to the physical institution. People can also inform themselves about the museum and its collections when a physical visit is not possible. This results in a conflict between offering access and maintaining control about the content while the consumption of cultural content changes (Bertacchini, 2013).

[9] http://www.youtube.com last accessed September 13, 2013.
[10] http://maa.cam.ac.uk/maa/ last accessed November 11, 2013.

Transferring contexts online: The digital object or its information representation needs to be a valid surrogate for the original. To achieve this, all contexts that make the original artifact significant need to be transferred to the digital surrogate. Museum information systems run the risks of degenerating into colorful catalogs of what museums have to offer while lacking the ability to transfer any knowledge or meaning.

User needs: The question of how user groups can become more engaged with the content museums offer on their websites is one of the driving elements in research around digital museums. User needs related to digital museum resources access are not fully understood yet and museum experts are often groping in the dark when designing tools for using these resources (Marty, 2008c).

Online experience vs. physical visit: For a majority of people, the museum website is still the single access point to learn about basic information such as ticket pricing and opening hours (Marty, 2008c). Ideally, museum information systems should offer experiences that differ from the experience of a museum visit - the main goal here is to make the experience unique and customizable (Marty, 2008c). Furthermore, with the help of new media in museums, new and remote audiences might be encouraged to interact with the museum without hindering the museums mission (Hazan, 2006).

With the technological possibility to digitize their material, museums have the chance to bring people closer to cultural heritage material. While visitors in the museum are often just consumers not allowed to touch anything, they can now become actively involved in shaping their cultural heritage online. To implement this, most museums embrace Web 2.0 technology. In this way, they hope to engage new audiences and make museum activities more transparent on different social media channels. Interaction with museum content will take place online for most of the museum's clients, changing the services museums need to provide and the way the public engages with cultural heritage (Freedman, 2000).

2.5. The Challenges for Cultural Heritage Information Systems

In the following section, the challenges for cultural heritage information systems are summarized and grouped to provide a holistic overview of the different aspects institutions need to take into account while designing engaging information systems. Cultural heritage information systems need to address many challenges that often arise through the different traditions of cultural institutions. Table 2.1 summarizes the differences between the three main cultural heritage institutions. These differences lead to several dimension under which the challenges for cultural heritage information systems can be subsumed.

2.5.1. Environment

Changing Roles

With the possibilities provided by the digital age, memory institutions grapple with their new role of becoming facilitators of knowledge exchange. Users are becoming increasingly aware of available digital resources and are less and less dependent on curators, librarians or archivists to research availability or existence of an item. Through this development, *"memory institutions extend their role as repositories to becoming participants in a broader discourse about heritage with the consuming public"* (Dalbello, 2009, p. 1). Resources of cultural heritage institutions are scarce, so user involvement might be the solution to broaden access to the vast amount of information online. There is the possibility to shift interpretation from an exclusive group of curators to the public. The opportunity to increasingly involve users in conducting interpretations is critically examined. The more the public gets involved, the more it is feared that in particular museums are losing their privilege of interpretation. A major concern are contradictory perspectives and opinions leading to a diverse set of interpretations without showing the user the "true" meaning of an object. User contribution to curation is extensively discussed, especially in the light of losing control and authority while allowing for possibly low quality content. Although some of these anxieties are legitimate, many experts understand this as an opportunity that cannot be missed if cultural heritage institutions want to stay relevant. Spock (2009) argues that participation will change the museum and its perception but is an unstoppable development that will redefine the self-conception of museums. Additionally, Pruulmann-Vengerfeldt and Aljas (2009) point out that there is a

Table 2.1.: Differences between museums, libraries, archives.

Attribute	Museums	Libraries	Archives
Objects	Uniquely shaped by meaning & interpretation	Interchangeability of objects, copies have same informative value (Pitti, 1999; Buckland, 1991, p. 33)	Unique due to their provenance & original order (Pitti, 1999; Theimer, 2012; Buckland, 1991, p. 33)
Information representation	Lack of known titles, dates & authors (Bearman, 2008)	Known authors, titles, dates (Bearman, 2008)	Lack of known titles, dates & authors
	Attribution of historical contexts (Bearman, 2008)	Bibliographic descriptions on item level (Pitti, 1999), they are "transcribed" (Bearman, 2008)	Bibliographic descriptions represent fonds described hierarchically (Pitti, 1999)
Digitization	Thumbnails and metadata from objects' context; they do not seem to benefit from offering digital surrogates, which might undermine a visit to their museum.	Digital metadata in OPACs, nature of material allows digital surrogates without context	Biggest access problem as the majority of their information is not visible
Authority control	Need to know all names that relate to an attribution (Bearman, 2008) with lack of standardization	Very standardized on national level	Plays marginal role
Online metadata standard	None, collection management systems (Novia, 2012)	MARC (Novia, 2012)	EAD (Novia, 2012)
Collections	Aggregated according to collection focus	Aggregated according to collection focus, legal deposit	Organic based on provenance (Hagel & Sieglerschmidt, 2002)

clash between users who are mainly used to entertainment sites and museums that do not want to give up their cataloging rules. Museums would rather have users adapt to their workflows than vice versa. If this attitude is maintained, museums may face the issue of losing users to other information resources.

The challenge here is to find the balance between the institution claiming excellence and authority in its field and giving users the freedom to engage with the content. A mind shift is necessary that acknowledges the public interest to attribute significance to objects they think matter.

Changing Cultural Record

The change undergone by memory institutions is to a great extent based on the changing form or medium of the cultural record. As described in chapter 2.1, cultural heritage is any form of tangible or intangible item that reflects human's culture. It becomes a cultural record when it is collected and documented by a memory institution. Typical cultural records are books, paintings, photographs, vinyl, instruments and administrative documents - all tangible entities. A digital surrogate gets added to it when the item or its describing metadata is digitized. Digitization also paves the way for preserving intangible cultural objects such as performances, spoken languages and dialects. Accessing these items and making them retrievable is a great challenge, for example when trying to find a specific scene within a recorded film of a performance. In addition, there are born-digital artifacts that are a product of human-computer interaction. They encompass social media content like Tweets and Facebook profiles, emails or forum entries. This so-called Personal Archiving is a major challenge which involves considerations on how different formats can be preserved over time. Whether and how these personal objects pass onto the collective cultural heritage is an open question and remains to be answered in the future.

The handling and maintenance of digital cultural heritage generates so much information and knowledge that strategies need to be in place to make our "cultural heritage knowledge base" (McCarthy, 2007, p. 257) understandable for future generations (McCarthy, 2007). Solutions are contextual frameworks that capture the different contexts of information associated with digital entities (e.g. C. A. Lee, 2011).

The form of the cultural record is changing and repositories of digital cultural heritage need to maintain their authenticity and integrity, especially for research purposes (McCrary, 2011). The digital surrogate of an artifact will in future always inherit a feature augmentation that makes the object become a new cultural heritage record, e.g. contextual links added to a digitized manuscript or book. This enrichment of digital collections with timelines and virtual tours blurs the line between the digital surrogate and born-digital material (Newell, 2012).

The different origins and purposes of the cultural record are increased by the diversity of the institutions preserving them. Objects coming from a library, museum or archive differ in their purposes and the metadata describing them.

Convergence of Services

Libraries, museums and archives are historically evolved entities that developed independently, especially due to the different purposes of their services. Recently, a shift toward a convergence of services can be observed, which is caused by the quest of cultural institutions to offer a broader access to their collections online. Marty stresses the functional convergence of museums, archives and libraries. He points out that users expect all institutions and their collections online to behave like digital libraries (Marty, 2007). This is very problematic as users have pretty clear expectation of library OPACs, e.g. finding a book by a particular author. An increasing amount of the cultural material is retrievable, which blurs the line between the institutions' initial missions and services that have grown through history. Tasks and purposes of libraries, archives and museums are different from each other. They serve different user groups for different reasons. This hints at the difficulties for system design when merging objects from these different strands into a single system and offering users the possibility to access cultural heritage material from one single access point. Experts argue that libraries, archives and museums must work together to establish a common ground of expert knowledge that can be presented in the digital world (Given & McTavish, 2010; Wythe, 2007). This is especially important as most users are not aware and often do not care about the traditions and mandates of different memory institutions. Dupont (2007) considers the relation to content and audience as the biggest difference between the institutions. In order to achieve collaboration in serving the user, they should promote a mutual understanding of their different goals and practices.

For users, the institutional segmentation of digital cultural heritage resulting in different services and access points is hard to understand. Generally, users want to access the material without wondering where it resides (Waibel & Erway, 2009). The vast amount of institutions digitizing their material made portals necessary that improve access across institutional borders. So-called aggregator portals are developed to unite access to digital material. They can be of regional, national or pan-European level, e.g. the Europeana portal[11]. The goal of these portals is to lower the entry barrier by creating a single access point to the material. But regardless of presenting the material on an institutional site or in an aggregated portal, the engagement of the users is implemented in very different ways depending on the underlying material and the availability of high quality digital objects.

An integral solution for digital material coming from museums, libraries and archives should guide the development of cultural heritage information systems. Memory institutions are taking the necessary steps right now, but still need to decide what this convergence means for the user. Advocates promise a richer user experience and increased access but do not specify how this can be achieved and what it actually means for the users. It is important to better understand the consequences and possibilities of broadened digital access in order to develop the interactive and engaging tools that support the user[12].

Influences of Web 2.0

There has been an emergence of new terms such as Library 2.0 and Archive 2.0, whose definitions can guide the development of purposeful interactions in cultural heritage information systems.

Through the co-word analysis of expert answers to the question "what is library 2.0?" Holmberg and colleagues coined a definition for Library 2.0: *"Library 2.0 is a change in interaction between users and libraries in a new culture of participation catalyzed by social web technologies"* (Holmberg et al., 2009, p. 677). They identified seven core principles that play an important role in library 2.0: *"interactivity, users, participation, libraries and library services, web and web 2.0, social aspects, and technology and tools"* (Holmberg et al., 2009, p. 677).

Similarly, Palmer (2009) sees Archive 2.0 as a shift towards a user-centered archival

[11] http://www.europeana.eu/ last accessed September 9, 2013.

[12] Three special issues were collaboratively published by Library Quarterly, Archival Science and Museum Management and Curation on convergence of libraries, archives and museums. Most of the papers focused on the internal challenges but neglected the user facing side of convergence. For an overview see Marty (2010).

service that fosters collaboration, sharing and openness. It means engagement with the content such as finding aids or actual digitized archival documents and interaction among users sharing interesting findings and contextualizing the content.

For museums, the discussion is slightly different and not centered around a term such as Museum 2.0. Simon states that museums need to shift their attention to let users participate within the museum context. She lists three positive outcomes for this shift in museums: the institution becomes more audience-centered putting the needs and requirements of users first, users get the possibility to *"construct their own meaning"* (Simon, 2010, p. ii) and can add additional context to the museum projects. These concepts are often aggregated under the term *Participatory Design* and focus on museum exhibitions. They are not restricted to the physical experience but include the online museum experience as an integral part.

2.5.2. Goals

Digitization Goals

There seems to be no common understanding of what kind of needs a digital object should serve except for being available online. In the beginning of the digitization phase, the need to digitize was either born from the idea to showcase valuable items from a collection or present the whole extent of a collection. Stiller (2006) distinguished several strategies for the digitization efforts of libraries which hold true for other cultural institutions as well:

1. Digital addition is aimed at offering wider access to cultural heritage material by digitizing its metadata and offering a thumbnail as preview.

2. Digital surrogate is aimed at representing the physical artifact completely, acting as a substitute.

3. Digital augmentation does not replace the tangible object but adds additional data layers, which enhances and improves either the information available about the object or the perspective of the object, for example through deep-zoom images.[13]

Digital objects serve different purposes for different memory institutions. For example, libraries want to offer the user surrogates online so they do not need to

[13]The third strategy in Stiller (2006) is the mass-oriented digitization that rather focuses on quantity than quality of the scans. By the time of the research this was a valuable argument but in present time, this does not need to be distinguished as a separate strategy anymore.

make the effort to come to the library. A digital representation or copy is as good as the original. Furthermore, their content is not bound to the context it is embedded in and can be understood on its own. Digital surrogates of museums are targeted at showcasing the highlights of the museum collection and enthusing the public to visit the museum. Even if a work like the Mona Lisa might be digitized in such way that you can see every brushstroke, the experience is different from seeing the real painting in the Louvre in Paris. In general, digital representation of an object should serve the purpose of simplifying access to the physical object. The heterogeneous goals of institutions lead to different conceptions of what kind of interactions should be offered to users.

User Needs and Expectations

To understand and design information systems a user can interact with, it should be understood what the underlying user intentions and needs are. Why do users interact with a system and for which purposes? What kind of different motivations can be distinguished? It is essential to point out that there is a difference between the intention a user has in mind and the translation of this intention into an interaction a system can understand. These do not necessarily match, and a good information system offers support for users to express their goals and interact efficiently with the system. An example is the information need of a user, which gets translated into a query if the system's primary access point is the search box. The query can be very ill formatted so that the results retrieved are not coherent with the user's expectations.

A lot of studies looked at the user input, analyzing transaction logs. The most expressive input a user can offer in traditional cultural heritage information systems is the query. User goals were derived from categorizations of queries in web search (Broder, 2002; Rose & Levinson, 2004; Baeza-Yates et al., 2006; Jansen et al., 2007; Spink et al., 2002) and digital libraries (S. Jones et al., 1998). Named entities and queries related to work titles play an important role in cultural heritage search (Stiller, Gäde, & Petras, 2010). In general, the users' intent derived from queries is prone to be biased. First of all, it is a translation of the users' information need into a short term, and how well users are managing to do that depends on their information literacy, their cognitive effort and the system's ability to support them in this process.

Apart from this, only marginal research exists on users' preferences and goals regarding digital cultural heritage resources. Often, this type of survey targets a

specific institution and asks users for the acceptance of a particular feature (e.g. Marty, 2011). In general, it is assumed that users want to engage with the content; they want to learn, find answers to their questions and get entertained. Dobreva, O'Dwyer, and Feliciati (2011) stress the fact that institutions assume they now their users and that online users are similar to the ones coming to the institution. Furthermore, they point out that solely building functionality and providing content is not enough of a strategy to stimulate use Dobreva et al. (2011). Accommodating these challenges and prepare institutions for future use that is not yet predictable is the challenge for cultural institutions.

An exploratory survey of online museum visitors on their expectations when visiting a museum website concluded that users want a unique experience from their visit that differs from the one they might have on-site (Marty, 2008a). How these expectations can be met and whether personalization and customization are the direction to take still needs to be figured out.

Diverse access points to the material need to be created to make users aware of the treasures hiding behind the search box. Users might have limited knowledge of what museums can offer and what the extent of a given collection is. Therefore, museum information systems need to provide entry points that enable the user to explore the unknown and support serendipity. They need to support interactions, tasks and use cases not yet foreseeable.

2.5.3. Content

Heterogeneous Content & Multilinguality

Digital objects coming from museums, archives and libraries are very heterogeneous. This is not so much due to the existence of different metadata formats, as they are normally mapped to an interoperable format that can be easily indexed by the system. The heterogeneity results from the non-standardized metadata fields. These fields are related to the context the described object or its representation is taken from. A creator field can hold the creator of the metadata record or the creator of the representation of the depicted object. So every object is described with regard to the contextual framework it was taken from. And although the actual object serves a different purpose than its digital surrogate, the same type of metadata is applied to it. Data models are developed to reflect this richness and complexity. For example, the Europeana Data Model (EDM) explicitly distinguishes between the object and its digital representation. It should always be clear which metadata field is referencing what semantic relation (Europeana Foundation, 2013, p. 8).

Cultural heritage information systems are often characterized by a multilingual dimension. Cultural heritage comes in a variety of different languages, many of which are not actively spoken anymore. The describing metadata is often in the language of the hosting institution. It is essential to address the question of how to retrieve documents in different languages with queries from a multilingual audience, which may result in a mismatch of document and query language. Research is dealing with the problem of multilingual information access. It has several levels that go beyond the simple matching of textual documents and queries in different languages (cross-lingual information retrieval). Peters and Sheridan understand it as the *"problem of accessing, querying and retrieving information from collections in any language at any level of specificity and includes all issues that involve the overall management of multilingual information"* (C. Peters & Sheridan, 2001, p. 52). Access is understood here in a broad sense including several issues where the language barrier needs to be overcome to enable users to get to resources or extract information they might not understand without system support. Multilingual information access adds an additional layer to the search problem, acknowledging contextual information such as the language and cultural background of the user.

Metadata for Experts

Cultural heritage information systems are facing the challenge to satisfy user needs of both expert and novice users. The metadata that accompanies digital cultural objects is made for experts, especially in the museum and archive domain. The descriptive metadata normally matches the core workflows in these institutions and was not initially created to provide public access to these resources. The systems of all three domains are targeted toward quickly finding items that the expert user knows exist. Most systems support only simple look-up and fact-finding (Amin et al., 2008). But the information seeking process of cultural heritage experts is also characterized by more complicated information processing workflows. Studies have shown that there are also big differences between experts from different disciplines and their search behavior (Yi et al., 2006).

The information systems that store cultural heritage data were never designed for public and non-expert use. Using them now via a publicly accessible interface requires expert help and knowledge. Creating means for novice users to access this material is crucial, and metadata as it is published now might not guarantee the best user experience.

2.5.4. Access

Interpretation of Cultural Material

In museums, the curator provides the subjective interpretation of items when forming an exhibition, and artifacts are acquired having their value for a specific collection in mind (e.g. Srinivasan, Boast, Furner, & Becvar, 2009). This interpretation is often not expressed in the metadata and therefore lost when the user retrieves it online. This is especially important for museums where context and meaning are referred to as cultural heritage interpretation. A user's guide to interpretation of cultural heritage writes *"interpretation doesn't just teach what something is, but what it means"* (Lancaster County Planning Commission, 2007, p.3). It is a central concern for all cultural organizations to find ways to associate meaning to a certain object. This is a difficult task that is always subjective and often socially constructed. The process of cultural interpretation for memory institution starts with the question whether a certain object should be acquired or preserved for future reference. Several guided steps can be undertaken to determine the value of an artifact in terms of its significance (Russell & Winkworth, 2009). Once the significance is determined, the object is already interpreted in a certain way. This interpretation is enforced by the exhibition the object is shown in and the context in which it is embedded.[14] The interpretation of cultural heritage is socially constructed and happens within the moral and ethic values of a particular group (Srinivasan, Boast, Furner, & Becvar, 2009). It serves as a crucial part of constructing national identities. Interpretations from different times and different people enrich our cultural heritage if others can reproduce the interpretation through the context in which it was created. For some, the loss of identity of objects already exists when the information representation is created, as only the object itself carries all the meaning (see Marty, 2008b). This is a valid point when assuming that there is a true interpretation. Every person in a society should be enabled to assign meanings to cultural heritage objects. These meanings can be documented and it is technically possible to link an object to different interpretation spaces. The handling and embedding of these different interpretations is one of the major challenges for memory institutions.

[14] An often cited example in this context is the exhibition of the Smithsonian Institution on the events and effects that lead to the bombing of Hiroshima and Nagasaki. It had to be closed down as the exhibition design suggested that bombing was a disproportionate measure against Japan - a view that is not consensus in the United States (Kohn, 1995).

Limited Access Points

Cultural heritage institutions need to broaden access to their material. Many challenges arise, especially when data is aggregated from different strands of memory institutions and their legacy systems. Presently, all cultural heritage information systems make their collections accessible with textual search. Matching user queries to the metadata of an object lets the user retrieve items. Search is determined by formulating a query, scanning the result list for relevant items and finding results that might answer the information need. This search paradigm, common for libraries, is transferred to other cultural heritage institutions. But many objects from archives and museums are not sufficiently described by their metadata (e.g. acquisition numbers and dates of acquisition instead of subject headings or keywords) and lack any form of subject headings. This leads to problems when offering unified access to cultural heritage resources. Retrieving objects with information retrieval techniques is a challenge that is due to the distributed nature of cultural collections, the different formats of their objects and their heterogeneous fielded descriptions resulting from different expert vocabularies (Koolen et al., 2007). Therefore, cultural heritage information systems need to offer access points that go beyond search. The common search box offers one entry point, but accommodating contextualization and collaboration can create more.

A query requires users to have an information need they can express, knowing what kind of content they can find in the system. Often this pretty static understanding of search is implemented in cultural heritage information systems offering users the search box in a prominent position. Early web search tried to stick to the library science model of manually curated web directories as navigators through the Internet before turning to crawling all websites and ranking them on the basis of the reputation of the incoming links. Although these principles do not apply to search in cultural heritage information systems, it is still the predominant retrieval technique. Advantages of structured metadata are often not fully used, with the consequence that fields are disregarded or not weighted correctly. Making the context of the document part of the search experience should be the goal of a successful cultural heritage search. To enable the discovery of the unknown, engagement access points beyond search are needed.

Loss of Context

Another area of concern is the loss of contextualization. During a museum visit, content is presented to the user and is interpreted through contextualization by a curator. Even without knowing what a particular museum or exhibition has to offer, visitors can have a fruitful, entertaining and educational experience. Context and meaning form an important part of cultural heritage but can hardly be transferred online. In cultural heritage information systems, most of the objects are ripped out of their context. Therefore, cultural institutions emphasize the need for exploration and browsing features. If users do not know what to find, it is beneficial to give them entry points for exploration. Amazon[15] found a very user-friendly way of mixing search and categorical browsing interchangingly (Morville & Callender, 2010, p. 27). This creates more context through the regrouping of items.

Context does not only offer interpretation for a particular item but also functions as the mechanism to evaluate the relevance of information. The context of a cultural heritage object depends on the collection it is part of and the circumstances that made the artifact significant.

Publishing cultural material online leads to an increasing de-contextualizing of the objects; often curators and experts cannot absorb this. User interactions with the material can serve as contextualization of the objects, witn would be too expensive and time-consuming if done by experts. The challenge is to minimize the loss of context that occurs when surrogates of objects are not embedded in their original background, such as collections. The ways of counteracting this consequence of digitization will also influence how cultural heritage information systems will be perceived by users.

[15] http://www.amazon.com last accessed September 11, 2013.

2.6. Summary

The challenges for cultural heritage institutions as stated above can be summarized in the following list:

Environment: Changing Roles, Changing Cultural Record, Convergence of Services, Influences of Web 2.0

Goals: Digitization Goals, User Needs & Expectations

Content: Heterogeneous Content & Multilinguality, Metadata for Experts

Access: Limited Access Points, Interpretation of Cultural Material, Loss of Context

These challenges shape the interactions cultural heritage information systems offer their users. They are the basis for understanding flaws and problems of these systems and how the public uses them. This thesis is set out to explain what purposeful interactions with digital cultural heritage content should entail and how institutions can strive to implement a strategy supporting meaningful interactions. This strategy should enforce interactions that serve users and institutions alike. Often the two sides have contradictory assumptions about the use of cultural heritage content. Users want to engage with it and get entertained while institutions tend to restrict interactions to ensure integrity and authenticity of the content. New technologies and the user-oriented shift to social services and software have also influenced the discussions in libraries, archives and museums on what this means for their services and their contact with patrons and online visitors.

Not only institutions shift, but also audience expectations. Users want to access the material and contribute to the cultural heritage together with the responsible institutions - in the best case at eye level. Supporting users in interacting with the digital cultural heritage in a meaningful way is the main challenge cultural heritage institutions need to address.

CHAPTER 3

Access through Interactions

Access to information is a central issue and concept in library and information science. With the rise of technology, access to information combines the possibility to obtain information with the capabilities of users on how to use and understand it. This development manifests its importance for the field through increasing research on information seeking behavior and the processes that enable users to make sense of the obtained information (Friedrich & Turock, 2009). Accessing information in information systems is always combined with an interaction; therefore aspects of Human-Computer Interaction (HCI), interaction and interface design and user-centered approaches influence access.

This chapter defines interactions and their relationship to the main access modes in cultural heritage information systems: *Search*, *Browse* and *Engage*.

3.1. Defining Interactions

In this thesis, *interaction* is the central term that guides the analysis and evaluation of cultural heritage information systems. The term as it is used here is anchored in the research field of HCI and needs to be differentiated from related terms focusing on the design of the system and experience of users. An interaction refers to any engagement or action between a human and a computer. In the context of this thesis, the term *interaction* includes one or more actions a user can complete in a cultural heritage information system, such as searching or browsing items. It also describes actions that support collaborative engagements, such as editing a user profile, uploading objects and creating collections. In the foreground of this

definition is the underlying purpose of the action undertaken by a user - the main focus in this thesis.

3.1.1. Interaction Research

The term *interaction* is used in several related disciplines with slightly different meanings. Research on interactions is mainly looked at from two different angles. One - *Interaction Design* - focuses on composing interactions and the implications of it on information systems. Two, *Information Interaction* focuses on the underlying information users interact with in information systems.

Interaction Design
Interaction Design wants to solve a specific interaction problem, but the solution is embedded into a certain context serving an explicit purpose (Saffer, 2009, p. 4). It wants to offer an easy solution for a common web task such as logging into an account or adding a tag to a resource. Research in this area understands interactions as part of a workflow to accomplish a task but yet has an emotional component. A. Cooper et al. (2007) understand the premises of *Interaction Design* to support users to achieve their goals, coupled with an emotional aspect of users getting satisfaction from interacting with a certain product. It should make them happy (A. Cooper et al., 2007, p. 3). This is closely related to *User Experience Design*, which unites the quest for designing efficient tools with the desire to make the tasks that should be solved with these tools satisfactory and easy to accomplish (Garrett, 2011, p. 6). Other researchers stress the fact that there is a gap between the interaction that lets the system perform in its best possible way and the interface that needs to be easy to use (Petrelli et al., 2006). Finding the right balance between the two requirements is the challenge that is addressed by *Interaction Design*.

When it comes to the implementation and creation of interactions, designers often refer to pattern languages as an adequate means to simplify design processes. In HCI, the use of patterns is considered to be beneficial as guidance for the development of the system design and suitable language for all stakeholders involved (Borchers & Thomas, 2001). A path of interactions is a *Design Pattern*[1], if it is the

[1]The concept of the *Design Pattern* was first shaped by the architect Christopher Alexander who constructed a so-called Pattern Language to provide answers for common architecture problems. For example, one pattern describes the bathroom and its definition and location (Alexander et al., 1977, p. 682). Each pattern refers to a problem that is reoccurring; the offered solution is generalized so it can be implemented in different ways (Alexander et al., 1977, p. X). Pattern languages as a means to simplify design processes were adopted by other domains.

solution for a recurring problem (Kunert, 2009, p. 7). Welie and Veer (2003) refer to patterns in *Interaction Design* as a *"proven solution to a problem in a certain design context"* (p. 1). The definition of an interaction is very similar to the one taken in this thesis; the interaction itself is objective and independent of design and performance of the given action. *Design patterns* are formed out of interactions that are established in information systems and can help to guide the development of new systems. In cultural heritage information systems, an adoption of certain design patterns from other domains can be observed. The simple search box and its inherited interaction is one of these design patterns that was borrowed from web search engines. The absence of an advanced search might be one hint that design patterns cannot be easily adopted across different systems. For example, Hughes-Morgan and Wilson (2012) studied three different interaction models with the same underlying metadata and found that the choice of the model makes a difference in how well users perform. This finding is similar to another study that was conducted in the broader context of digital libraries. Its goal was to understand user interactions better and derive requirements for design by comparing different browsing and search features and their influence on the user's performance. The results suggest that poor design choices are leading to a drop in performance (X. M. Zhang et al., 2008). This shows that interaction models and design need to be adapted to the underlying content and is structure.

Information Interaction

Information Interaction is the search for particular information and the interactions the user is having with an information system in doing so. Toms (2002) identifies three entities as the basis for an information interaction model: user, system and content. Marchionini (2004) argues that *Information Interaction* augments information retrieval. Information retrieval, which focuses on information objects and the relations between them, is extended to the field of information interaction, which interactively considers the input of the user during the search process (Marchionini, 2004). Each of the interactions results in a change of the entities involved (Marchionini, 2008). In general terms, interaction with information involves contextual user information such as the user's information literacy or location. Kelly and Belkin (2002) propose a framework with similar assumptions for user modeling in information retrieval systems, which includes user behavior and its effects on the search process. Pike et al. (2009), however, suggest that interactions are a process through which knowledge for the user is derived or altered.

The term *interaction* as it is used in this thesis focuses only on the function of an interaction. Design implications and the usability of an information system are subordinate to the question which interactions can be considered to be purposeful. It is more important to examine which goal a certain interaction is set out to fulfill.

3.1.2. The Relationship between Interactions and Information Access

Especially in the cultural heritage domain, it is not possible to rely on established interactions. Interactions in cultural heritage information systems are shaped by the underlying content and the design of the system. In a general attempt to improve interactions and digital library design, Bates (2002) proposed a cascade of interactions in information systems. She states that it is important to understand the different parts of a digital library and their interplay. Her model, theoretically dissecting a digital library into strategic parts, suggests that each component of a digital library influences the design of the part built upon. On the basic level of information systems are the content and the technical backbone. Built upon this, different layers are following, each influenced by the preceding one. The top of the cascading layers are the user's expectations and interactions with the system (Bates, 2002).

A much more simplified model derived from Bates' assumptions determines that every information system (also outside the cultural heritage domain) strives for seamless interactions between the users and the content. The layers in between - on the one hand the system that enables access to the content in all its facets and on the other hand the interaction patterns and interface functionalities that enable the user to interact - should be as intuitive as being invisible to the user (figure 3.1). Murray calls this concept transparent; it means the interface should not distract users from their tasks, offering them interactions they can intuitively execute (Murray, 2011, p. 10). Cultural heritage information systems should strive for transparent interactions.

User interactions with the content are based upon and support the different access modes a system provides. These can be broadened and further enriched by the user creating more access points. From a generic perspective, interactions with the system provide access to information by encompassing all aspects from finding a resource and using it to making sense of it. Information access in cultural heritage information systems consists of three main modes of *Search*, *Browse* and *Engage*, which are similarly described in Petras et al. (2013):

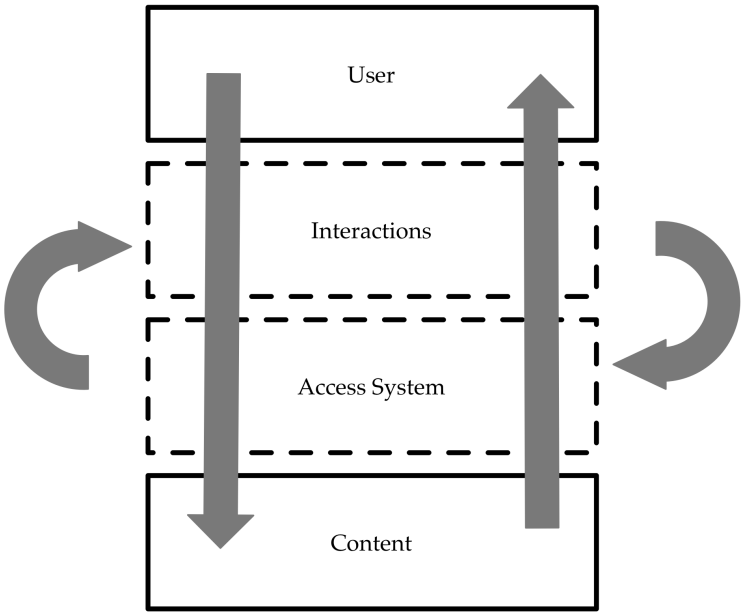

Figure 3.1.: Model of a transparent information system and interplay of its components.

1. Search: The possibility to retrieve objects from a collection via a query or through other forms of input such as an image or a color. Users retrieve objects for which they have a vague idea that they exist.

2. Browse:[2] The possibility to retrieve the unknown and discover content based on certain topics or themes. It also consists of navigating the content and regrouping it along certain characteristics.

3. Engage: Interactive participation of users in the development of the underlying content through collaborative tasks. It includes not only consumption but also generating content and altering it.

Strategies for information seeking, as one concept of information access, often encompass all three modes *Search*, *Browse* and *Engage*. Research in this area, such as information seeking behavior, often focuses on the interplay of these access modes but does not relate them to particular user interactions. In a major study, Cool and Belkin (2002) developed a framework and classification schema for information seeking behavior and the interactions with information (Cool & Belkin, 2002).

[2]Petras et al. (2013) call this access mode "explore and discover".

It focuses on the information seeking process providing five facets that describe different work flows and processes. Besides communication and information behavior, the framework describes the objects interacted with, dimensions of interactions and interaction criteria (Cool & Belkin, 2002). Pettigrew et al. (2001) stated that the impact of information behavior theory on system design remains rather minimal, as frameworks offer no suggestions on how to implement a better design.

This thesis wants to bridge this gap and takes a new approach by linking the modes of access to interactions. The modes of access are related to all interactions of a user in an information system. These interactions shape the modes of access and determine the amount of access points. Some of the access points might be provided by the system, others are created by users leaving their traces in the system. The modes of access are built on one another with an increasing complexity of the associated interactions and an increasing number of possible interaction patterns and access points.

Linking the different modes of access to interactions is based on several premises:

1. Modes of access are shaped through interactions.

2. Modes of access build on top of each other, from *Search* to *Browse* to *Engage*.

3. The more interactions, the more access points are created in the associated mode of access.

4. The higher the access mode, the more complex interactions are provided by the system.

Figure 3.2 shows a model of a transparent information system visualizing the different premises and the relationship between access modes that are formed through the provided interactions. The hierarchy of the access modes is determined through the number of interactions a system needs to provide in each mode and the access points that are available per mode.

The aim of this thesis is to get a global understanding of purposeful interactions in cultural heritage information systems. The main characteristic of an interaction is its relation to one of the access modes *Search*, *Browse* and *Engage*. These pillars of access in cultural heritage information systems are explained in more depth below.

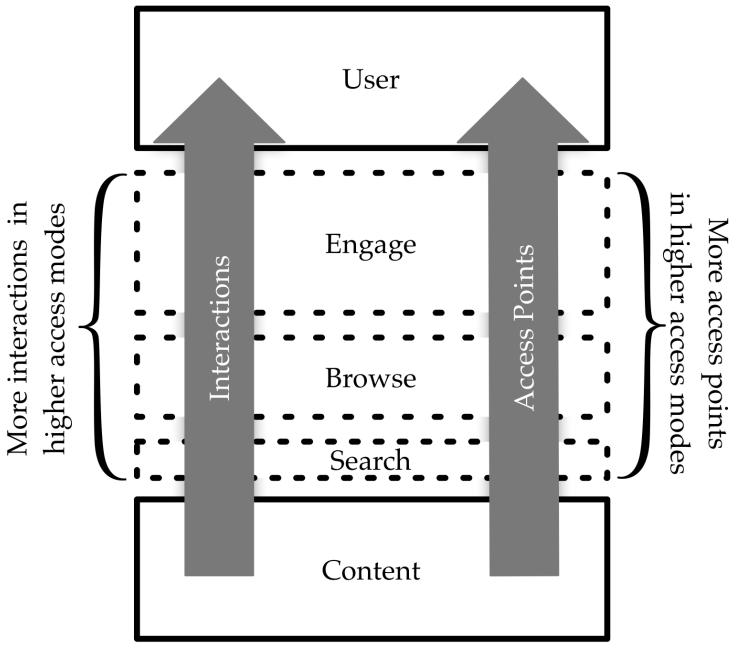

Figure 3.2.: Transparent system with access modes *Search*, *Browse* & *Engage*.

3.2. Search

In most information systems, search is the most important access mode. The user interacts with the content of an information system by inputting a query into a search box.

3.2.1. Researching the Search Process

Often, *Search* is synonymously used with the term *information access*. Searching is part of the more complex information seeking process the user undertakes to find the right information. Several areas research the search process, focusing either on the system or the user side of the process.

System-centered Research

Search is the fastest way to satisfy an information need, given that the user can formulate a successful query. A system matches the information need expressed by the user - the query - and the object representations in the form of textual metadata. The discipline dealing with all technical implications of this process is Information Retrieval (IR). It can be defined as a bundle of techniques and methods to identify

relevant documents, which are likely to satisfy a user's information need (Agosti, 2008). In general, IR research ranges from very technical approaches to ones that are more user-centered and contextually aware. Kelly (2009, p. 13) identifies the range from having a pure system focus to human needs and behavior in information retrieval systems.

User-centered Research

Besides the term *Search*, the concept of *information searching* has come to be used to refer to *"users' purposive behaviors in finding relevant or useful information in their interactions with IR systems"* (Xie, 2009, p. 2592). Here the emphasis is on the users' behavior and their strategies in information seeking. IR is the process the system executes to support users in their task. The process of sense making and understanding is the part of the search that rests with the user but can be supported by the system design.

Research on information seeking and information seeking behavior focuses on the user side of the information seeking task and how information systems can support the cognitive load of retrieving information and embedding it into the broader context of the user's information space. Different models and theories were developed which explain the process of information seeking from various viewpoints. Four models are routinely cited in this context: the standard model mainly attributed to Sutcliffe and Ennis (1998), the cognitive model presented by Norman (1988), the berrypicking model proposed by Bates (1989) and a staged model presented by Kuhlthau (1991). All these models have an initial information need or information deficiency in common. Satisfying this need is the goal of the information-seeking task even if the focus of this goal might shift in the process, as it does in the berrypicking model (Bates, 1989). Another user-centered perspective of search is represented by research on information behavior. Fisher and Julien (2009) investigated core problems in this area and found it to be still struggling with recyclable concepts and an overuse of imprecise vocabulary. The lack of acknowledgment of the research outside its domain can be a reason why information behavior research leaves few traces on system design.

There is a trend in exploring search from different perspectives which is shifting the focus more and more on the system components the user interacts with. Marti Hearst, for example, writes in the preface of her book on "User Search Interfaces" that her book *"focuses on the human users of search systems and the tool they use to interact with them: the search user interface"* (Hearst, 2009, p. i). Morville and Callender

(2010) sum up the characteristics that define search and that should guide development of search applications. They state *"search is iterative, interactive, social, and multisensory"* (Morville & Callender, 2010, p. 20). Deriving recommendations for system design from that is genuinely hard.

Another component of the search process, the queries, are often the subject of research which focuses either on categorization or the user intent.

Query Analysis Between System- and User-centered Research

Queries constitute an important user input that can be used by information systems to better understand their users. Understanding queries, the representations of an information need, is one of the basic ingredients for successful search interactions. Several studies analyzed queries - their intent, their goal and meaning for categorizing purposes. A classic study conducted by Broder (2002) classified web queries into informational, transactional and navigational queries. This taxonomy was adapted in manifold ways by broadening and refining categories and determining their distribution, finding that more than 80% of the queries are of informational nature (Jansen et al., 2007). Other studies focused more on associating queries to the actual underlying goals and intents the user wants to express (Rose & Levinson, 2004). Kellar et al. (2006) defined information seeking, information exchange and information maintenance as primary goals of queries. Further research tried to automatically categorize user intent and categories by using click-through data (e.g. U. Lee et al., 2005). Automatic query categorization is challenging, as even manual categorization struggles to disambiguate the intent of the user. Web search engines countersteer against a potentially bad user experience by offering a wide variety of information resources that cover the different query goals.

Beyond Searching

There is an increasing amount of research focusing on information discovery that goes beyond search and often has elements of browse and explore. For example, the concept of *Exploratory Search* merges all search- and browse-related tasks that have no clear goal or develop one only during the search process (see Marchionini, 2006). It involves numerous activities related to investigating and learning, which makes exploratory search rather a process of browsing than a focused search activity (White & Roth, 2009, p. 22). In a workshop at the SIGIR conference 2011 named "Entertain me", the focus was on exploring the possibilities of successfully performing complex search tasks, which are expressed in a single query (Karlgren, 2011).

The goal was to cover all possibilities and executable actions that might underlie a short query such as "entertain me". These developments are beneficial for cultural heritage material, because they initiate discussions about relevancy in certain domains or for particular queries.

3.2.2. The Search Problem in Cultural Heritage Information Systems

Search is an integral part of the information seeking process, but when cultural heritage institutions rely solely on it, most of the cultural treasures remain hidden from users. The search action as such requires some sort of information need to be expressed in a query. Looking at cultural heritage information systems, search seems to be a rather unnatural form of access, considering that users might not be familiar with the system or be aware of the available content. This creates a barrier, as users need to provide an input to interact with the content of a cultural heritage information system, which is difficult when they do not know what to expect.

Research on the particularities of information interactions and information seeking behavior in the cultural heritage domain is rare. Amin et al. (2008) studied the information seeking behavior of cultural heritage domain experts, coming to the conclusion that there is a gap between the needs of the experts and the offered tools for their work. Some studies in this area focused on single aspects or dimensions of the information seeking process, such as cross-lingual retrieval, and their influence on the information seeking behavior of users (Petrelli et al., 2004, 2006). The content and its implication for the type of interaction were of marginal interest. Other work looked on the shortcomings in the design or the underlying information architecture of cultural heritage information systems. For example, Liew (2005) performed an analysis of information retrieval features and the provided search and browsing capabilities on cultural heritage websites. Although this study is already a couple of years old and has an explorative nature, most of the findings are still true for many cultural heritage information systems today - they offer a unified interface for all users, and implementation of multilingual search features is limited.

Providing different search features for a variety of audiences should be an offering cultural heritage institutions need to explore more. In their studies on search terminology of humanities scholars, Bates et al. (1993) concluded that search behavior and used terminology are very different between the humanities and the sciences. Bates also stresses that information systems design can be misguided when the indexing system is different from the search system (Bates, 2002). This also seems to be the problem of cultural heritage information systems. Their index-

ing systems are made for known-item retrieval and subject access (libraries), accession by creator (museums) and provenance (archives), whereas the public assumes that their search will work similar to the one offered by Google[3]. There is a mismatch between the information seeking process of different users and the look-up based retrieval model offered by most information systems. This model supports specific queries with the goal to present the most precise results (White & Roth, 2009). To overcome these limitations, recent research focuses on other aspects of search that go beyond the simple information retrieval paradigm to match queries to text. There is a move from textual search to other forms of content retrieval which are based on different principles than natural language processing. Image search, for example, deals with search by color or other visual "queries". This does not only require systems that can handle different queries such as a picture query, but completely changes our perception of how users express an information need. Tsai (2007) reviewed several cultural heritage digital libraries to gather information on the offered method to query images (only considering digital libraries that offered image querying). He concludes that the image retrieval methods are still limited letting the user query the image content but often have no further developed functionality such as browsing or semantic/based retrieval.

Query analysis in the cultural heritage domain has shown that the queries are different in some aspects from the ones usually found in web search engines. A high number of queries express a search for named entities. A specialty of this domain is the search for work titles such as "Radetzky Marsch" that might indicate a known-item search and should be treated in the same ways (Stiller et al., 2010). Other aspects are similar to web search queries, for example with respect to the length of the query or a session.

In general, cultural heritage information systems have to deal with the ambiguity of queries and focus on how to offer users the best possible search experience. A named entity search for an author such as "Shakespeare" can have the goal of finding a specific work written by Shakespeare or have an informational goal of finding his biography or other secondary material. Automatically determining relevant documents for a particular query is an unsolved challenge. Even for human evaluators, it is hard to determine which documents should be shown for queries such as "Shakespeare". Short queries do not give much information for the system to adapt its offerings. Web search engines push for user profiles where they can infer the user's preferred language and interests and also store previous queries

[3] http://www.google.com last accessed September 15, 2013.

and the resulting clicks. Cultural heritage institutions are rather reluctant to take similar measures. On the one hand, they do not have the same amount of data to statistically determine the likelihood of certain goals for an ambiguous query. On the other hand, there are privacy concerns in tracking users and their behavior.

Generally, online search is the primary access feature for cultural heritage institutions. Search as a means to access the cultural material requires an information need and some understanding of the underlying metadata. Search mainly supporting fact-finding and the look-up of known-items is indispensable for libraries. Their OPACs perform very well in this type of retrieval, and the information representation system of libraries is designed to support fact-finding. Nevertheless, Waller (2009) found that 45% of the query input to the catalog of the State Library of Victoria[4] are of informational nature, looking for general information on a topic. Libraries are specialized in answering these type of queries and users seem to have adapted to using these systems.

In this thesis, *Search* is an access mode characterized by interactions to find the objects users are looking for. It includes all interactions that help support the users in retrieving the facts and objects matching their input, such as a query. *Search* is a primary access mode that related to all interactions in a system. Potentially, all content in a system can be searched ranging from cultural heritage objects, to user names, their contributions and comments.

Search can be further broadened through interactions of users that create more points of access. For example, user comments, social tags or other contributions can be searched and used as contextual information for cultural heritage objects. The more interactions are offered in a system, the more content can be potentially searched. And the more content is created and interlinked, the more it can be accessed through search. Compared to the other access modes, *Browse* and *Engage*, *Search* is simple in its interactions. This means that all content can be searched, but not all content can be engaged with.

3.3. Browse

In this thesis, *Browse* is considered to be an access point that is distinguished from *Search* as it does not require a query to find information or get a general idea about the collection or items offered in an information system. The research literature often refers to *Browse* as an activity of users in the process of information seeking.

[4] http://www.slv.vic.gov.au/ last accessed November 11, 2013.

In information seeking research, browsing and searching are often closely tied together. These two activities are interconnected in the process of finding information. As browsing often demands different requirements from system design and results in different interactions than searching, it is examined here as a separated activity.

3.3.1. Browse as Part of the Information Seeking Process

The term *Browse* or *Browsing* embodies a multitude of concepts, which all originate as integral parts of an information seeking process. Chang and Rice (1993) reviewed the research literature and found four ways in which authors describe or refer to *Browsing*: integrated within the search process but different from it, equivalent to searching, as a distinct part of the search process or *"extremes of multiple overlapping and continuous dimensions of information behavior"* (Chang & Rice, 1993, p. 233). They propose a framework for browsing that embeds four different dimensions, namely context, influences, browsing process, and consequences. Behavioral and motivational aspects of the user influence the browsing process as well as the users' knowledge about the information they are seeking and how the resource is represented (Chang & Rice, 1993). The composition of these different dimensions might be different in cultural heritage information systems. In a later adaption of the framework, they explicitly mention the goal as one characteristic dimension of browsing, such as evaluating an information object or getting entertained (Rice et al., 2001, p. 289). This is in contrast to the preceding literature, which does not distinguish between object and goal and views browsing as opposed to searching with a specific object in mind (e.g. Waterworth & Chignell, 1991).

Browsing is described as one step or an embedded strategy in the process of information seeking. It enables the user to examine information from different perspectives and regroup it according to certain facets and characteristics. Generating new views on a dataset is usually referred to as pivot browsing. This form of browsing is often applied in tagging-based systems where every connection is a link which can be clicked to present data that is regrouped according to a different point of view (Millen & Feinberg, 2006). Browsing features are important access points in information systems as they allow the user to find related content pre-grouped by certain characteristics.

The broad use of the term *Browsing* is usually equated with a purposeful activity characterized by a vague information need (Cove & Walsh, 1988). *Browsing* is described as being cognitively easier to perform than searching with a query and

retrieving relevant results from a list - known as recognition over recall paradigm (Cove & Walsh, 1988; Hearst, 2009, p. 74).

Browsing and navigation are sometimes equated (e.g. Noerr & Bivins Noerr, 1985; Hearst, 2009, p. 75) and in this interpretation refer to the activity of more or less purposefully following navigational links. However, Waterworth and Chignell (1991) stress the fact that they are indeed different activities where navigation is only about choosing certain paths and browsing provides the reasons for doing so.

In Bates' berry-picking model, *Browsing* is one of the techniques for seeking the right information (Bates, 1989). In a later article, Bates defines browsing as a process consisting of four activities, namely glimpsing, selecting, examining, and, at the end of the process, acquiring the information item or abandoning it (Bates, 2007b).

Browse can also be loosely described as *Exploring*. In this interpretation, it is a way to explore unknown items, which supports the serendipity aspect of stumbling across information the user was not aware of before. Serendipity is the incidental discovery during an information seeking process that might support the user in generating new ideas and weighting the importance of existing information items differently (Foster & Ford, 2003).

Browse as an activity is also attributed to certain user groups. For example, Dörk et al. (2011) introduced the term information flaneurs. They present a new model for understanding information seeking behavior as interactions with information spaces. The analogy of an information flaneur distances itself from the models of purposeful search behavior that is directed towards satisfying some sort of information need. A similar metaphor is used when Petras et al. (2013) speak about information tourists - users who come to explore what is there, guided by their interests and leisure experiences. These users might not stick to an information source but might come back irregularly for further entertainment. Addressing different and new user types in information systems research is beneficial. In this context *Browse* is vital for user groups that are not yet well researched - mainly the ones who want to get entertained, pass time or have no specific purpose for visiting a certain system.

3.3.2. Browse in Cultural Heritage Information Systems

Digital cultural heritage does not only challenge the perception of cultural heritage institutions but also the tools used for presenting, analyzing and using information. The vast amount of information residing in cultural heritage records can now be analyzed with natural language processing tools, allowing researchers to see

items from a whole new perspective. This new discipline referred to as Digital Humanities lets researchers *"harness digital toolkits in the service of the Humanities' core methodological strengths"* (Presner, 2009). In this context, the tools for exploring and discovering text and cultural heritage items are reevaluated. One approach is rich-prospect browsing that lets users grasp the whole extent of a collection while offering means to change the perspective of the view and display (Ruecker et al., 2012, p. 3). Some of the cultural heritage information systems embrace this concept by applying faceted browsing to their collections, which allows refining search results according to aspects found in the metadata of the cultural records.

Browse can be considered an impactful tool for offering users access to collections whose extent and scope is not extrinsically assessable. With the amount of digitized content flooding the online information space, the web is full of information that is discovered by users for the pure entertainment factor. It acknowledges the fact that exploration and serendipity are becoming more and more important, as the extent of most collections of information is not transparent and users cannot be aware of what they might find. To lower the entry barrier for users, memory institutions curate online exhibitions and highlight the most important artifacts of their holdings to offer users a point for exploration. Browsing functionalities are more and more implemented but mostly reflect the information found in the metadata fields. To support exploration of cultural heritage collections, new tools and strategies need to be provided. For example, the Paths project[5] developed a prototype where users can search and browse the collection but also follow predefined paths provided by experts or other users. It resembles the concept of storytelling, engaging users by letting them retrace a chronological narrative from which they can always branch out and return to (Goodale et al., 2011).

In the context of this thesis, *Browse* is a means to discover information objects from different viewpoints. Browsing features are crucial for digital libraries. They support serendipity and the discovery of unknown resources. For users, the extent and scope of collections in these information systems is vague and not transparent. Therefore, innovative browsing capabilities are needed. The more data is linked (amongst each other or to external resources) and the more its structure is exploited, the more possibilities can be offered to browse and explore the content.

Through user interaction, the structuring and grouping of data can be introduced easily. This requires more interaction opportunities in a system than a simple search box. But often new structures and contextual groupings of the data unfold once

[5] http://www.paths-project.eu/ last accessed September 13, 2013.

users interact with a system. Compared to *Search*, *Browse* presumes more complex interactions, in return these interactions create more access points to the material.

3.4. Engage

Engage is the most complex access mode that encompasses interactions that are not based on pure consumption, such as *Search* and *Browse*. When searching or browsing, the user consumes information items as provided by the information system. If users interact with an information system's content in the *Engage* access mode, they edit existing content or add new content collaboratively with others or alone (Frieseke et al., 2011, p. 18). In this thesis, *Engage* comprises all interactions by users who add their own content and viewpoints, collaboratively or individually working on content creation or participating in activities centered on the content of the information system. *Engage* means to interact with other users, to comment, edit, and rate other contributions as well as the existing content base, which ultimately adds something to the information system environment, if not the original content itself. Engagement involves active feedback from the user and therefore leads to identification with the content. Additionally, it enables sharing and social interaction within and beyond the system's scope.

It is often associated with Web 2.0 features and social software, which can range from bookmarking to sharing to the creation of user-generated content (O'Reilly, 2005). In accordance with the definition of Web 2.0, engagement marks the shift from a web of passive consumption to a web of participation. It requires technological change to provide but also entails different behavioral patterns and goals (Holmberg et al., 2009).

The three main concepts within the *Engage* access mode are participation, collaboration and crowdsourcing. While participation is an individual activity, collaboration happens within groups, and crowdsourcing potentially involves people beyond the ones using a particular system.

3.4.1. Participation, Collaboration and Crowdsourcing

Although opinions differ on what exactly defines engagement, there seems to be agreement that it is closely related to the terms participation and collaboration. Often, participation is seen as the prerequisite for engagement (Simon, 2010, p. 5), (Buraimo et al., 2011, p. 4). Not everyone wants to participate to the same degree, as it might involve stepping out of anonymity and producing content. Forrester

Research names seven overlapping engagement profiles people can take on when visiting a website with social features: creators, conversationalists, critics, collectors, joiners, spectators, and inactives (Bernhoff & Anderson, 2010). Depending on which web services are used, users tend to switch between these roles. The same person can belong to different profiles at the same time. In general, the ratio of passive readers versus actual contributors is very uneven. Jakob Nielsen established the 90-9-1 rule, saying that 90% of the users are readers and observers whereas the rest is made up of 9% of users contributing from time to time and 1% of heavy contributors (Nielsen, 2006). Simon (2010, p. 8) highlights the importance of these different user roles for the design of participatory museum exhibitions. Preece and Shneiderman (2009) established a framework for social participation. It describes user behavior in social applications saying that most of the users are readers of which many become contributors, some collaborators and a few leaders. For each group motivating factors, that either influence the sociability or the usability, are cited making this framework a valuable tools for system design.

While participation happens on an individual level and does not need to be a group experience, collaboration is social. Collaboration is every form of people working together to reach a common goal. Online collaboration is augmented with the dimensions of being distributed and happening remotely. To collaborate, online tools are needed that overcome the barriers of working with people scattered around the world and not knowing each other. Collaborative tools support communication and easy updates among participants of a collaborative group. Examples are chat functionalities that enable users to communicate one-on-one or in groups and functionalities that allow everyone to see what others are doing in real-time to avoid double work. Other active or passive communication channels to ensure progress can broaden this bidirectional communication.

In general, there is a development from participation to collaboration that Simon (2010) expresses in five stages (figure 3.3). These stages represent the levels from individual participation to social collaboration.

A special form of collaboration online is crowdsourcing. This term, which has become very popular in the last decade, describes the distribution of small amounts of work to many people with the potential of generating revenue. In 2006, Howe (2006a) coined the term in an article in the Wired magazine where he first described the phenomenon. In his definition, crowdsourcing is the *"act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call"* (Howe, 2006a).

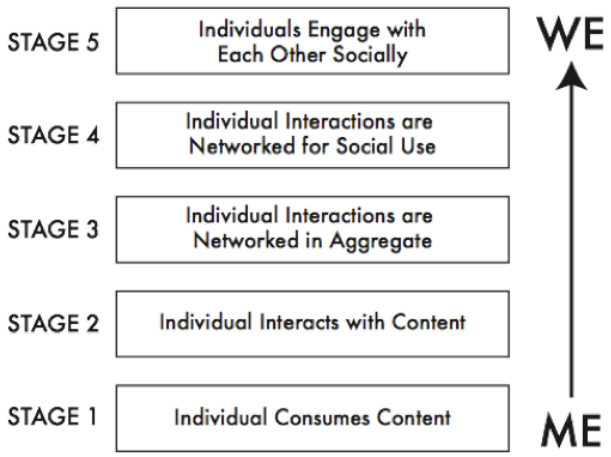

Figure 3.3.: Five stages of social participation (figure taken from Simon, 2010, p. 26).

The outcome of crowdsourcing is not a single smart decision but the possibility of many people sharing a certain workload that cannot be afforded by a single company paying for it (Surowiecki, 2005). Especially the construction of a folksonomy is often awarded crowd wisdom, as it is created by many individuals forming a sophisticated taxonomy which takes all contributions into account (e.g. Al-Khalifa & Davis, 2006).

Social tags, comments, reviews, ratings and other forms of user-contributed data that add additional information to a resource are referred to as social metadata (Smith-Yoshimura & Shein, 2011, p. 10), often also as user-contributed metadata. Holley (2010a) calls this *"social engagement"* which is *"undertaken by individuals for themselves and their own purposes"* (Holley, 2010a). If these tools are used by a group of people working collaboratively to pursue a shared goal, she identifies this as crowdsourcing. The advantages of crowdsourcing encourage cultural institutions to choose such an approach (e.g. Holley, 2010a):

- community building,
- improvement of access,
- improvement of quality, and
- fast and inexpensive.

Organisciak (2010) analyzed motivations of users to participate in crowdsourcing initiatives. He derived the following primary motivators for users to participate: money, interest in the topic (passion), ease of entry and participation, altruism and meaningful contribution, sincerity, appeal to knowledge / opinions (Organisciak, 2010). If cultural institutions can implement just some of these motivators, they may be able to build productive communities that contribute high-quality content.

In the cultural heritage domain, it is also hoped that large audiences will enrich the digital cultural heritage material. Cultural institutions, often lacking the necessary resources, could profit from enrichments contributed by users. Oomen and Aroyo (2011) classified crowdsourcing activities in the cultural heritage domain, identifying six types of crowdsourcing initiatives: contextualization, complementing collections, classification, co-curation, correction and transcription tasks, crowd funding.

With the shift in roles of memory institutions, the users' expectations to actively participate and engage with cultural material online have become stronger. Many institutions hope to reach broader audiences. When offering *Engage* interactions, access to the content is also broadened due to many newly created access points. Several activities to engage users with digital cultural heritage are discussed and often implemented in such systems, namely social tagging, storytelling and user exhibitions. Their characteristics will be further described in the next subsections.

3.4.2. Social Tagging

The tagging of objects plays a big role in the discussion about user participation in cultural heritage. Most cultural heritage institutions are interested in using folksonomies to increase the findability of cultural material and engage the users (Vliet & Hekman, 2012). A tag is a term that is assigned by a user to an object for describing this object further. If this happens in a collaborative environment online, it is referred to as 'social tagging'. A set of tags within a given system form a folksonomy. This term was coined by Vander Wal and binds together the two terms 'folk' and 'taxonomy'. For Wal (2007), folksonomies are naturally formed classifications by non-experts, presenting an alternative to controlled vocabulary applied by information professionals. Tagging is mainly discussed as a means to enrich metadata and as a substitution for controlled vocabulary where it represents the users' interpretation of the document's content (I. Peters, 2009).

Most studies in the field examined advantages and possible trade-offs of folksonomies. Especially the quality and usefulness of tags were investigated (Golder

& Huberman, 2005). In the literature, researchers list advantages for information systems when implementing social tagging features. Common reasons for offering social tagging in information systems are the opportunities to:

- offer a possibility for users to organize their personal content,
- enable the user to discover similar content and users based on shared tags,
- group similar content together,
- enable users to express their personal view with the tags, and
- enable pivot-browsing through re-grouping of the content.

There are several models for folksonomies. Either users can add as many tags as they want, including repeated tags which enable the system to assign certain weights to often occurring tags, or tags can only be assigned once. No matter which model is implemented in a given system, the relationship between the user, the tag and the resource adds an additional layer of access points to the material.

Over the past few years, researchers have studied the usefulness of folksonomies to improve information access in information systems. For example, one focus of studies is the users' tagging behavior (Marlow et al., 2006), the language used and the value of these two features to inherit knowledge and meaning. In museums, tagging enables users to add their perspective and meaning to an object, augmenting the existing controlled institutional vocabularies and classifications (Cairns, 2011). Studies in libraries draw similar conclusions; folksonomies engage users and help them to browse library catalogs in more depth (Anfinnsen et al., 2011). In a study, 50,000 tags applied to 1,785 artworks were processed by applying solutions taken from computational linguistics (Klavans et al., 2011). After data cleaning, the dataset was reduced by 80%. Editing tag sets linguistically (e.g. plural/singular variances, word endings, ambiguities and noise) seems to address most of the weaknesses free tag sets inherit (Klavans et al., 2011).

Another study investigated whether social tagging can reduce the semantic gap between curators and audiences (Chae & Kim, 2011). Collected user tags were assessed by museum curators for added value and their ability to express semantic relationships. The curators concluded that deriving meaningful information and semantic relationships from tags is very limited due to a lack of order, linguistic issues and ambiguity. Allowing users to assign tags to predefined facets led to better results. In addition, the cognitive effort of categorizing tags in predetermined

facets will be probably higher than adding free-form tags that might lead to fewer user contributions (Chae & Kim, 2011). Whether this improves the accessibility to the tagged objects was not part of this research.

User tags can be helpful to enrich and augment existing metadata of cultural heritage objects. They also add an additional interpretation layer that reflects the user's point of view. Leveraging tags for optimal results is the focus of ongoing research.

3.4.3. Storytelling

Storytelling is one of the oldest forms of communication in human history. Storytelling brings history to life and is linked to a richer learning experience. It has been used throughout human history to pass cultural values to the next generations (Hurlburt & Voas, 2011). With the transcription of these stories in written language it became possible to reflect on their meaning in different cultural stages. It also allowed for the stories to be preserved (Hurlburt & Voas, 2011). The introduction of the printing press sounded the bell for mass consumption of stories and their distribution outside local communities.

Davis defines digital storytelling as *"a form of short narrative, usually a personal narrative told in the first person, presented as a short movie for display on a television or computer monitor, or projected onto a screen."* (Davis, 2004). Porter's definition is more lyrical: *"Digital Storytelling takes the ancient art of oral storytelling and engages a palette of technical tools to weave personal tales using images, graphics, music and sound mixed together with the author's own story voice"* (Porter, n.d.). Digital storytelling is seen as a medium that empowers students to interact with learning material and reflect on it by making learning a personal experience. Robin (2008) points out that the most important benefits of digital storytelling are the different forms of literacy students acquire, especially in handling information and technology and producing contextual experiences they can relate to. The digital storytelling association emphasizes the collaborative character of digital storytelling and the mixture of different media types such as video, pictures, music that can be blended together to create a rich experience. An important attribute of digital storytelling is sharing and preserving.

Storytelling is a central term in cultural heritage information systems. Cultural heritage institutions provide and preserve the artifacts that are the basis for storytelling. It is seen as an important part of the cultural heritage experience, and it is often stressed that storytelling enables the audience to bond with the artifact by giving it context and meaning (Johnsson, 2006). In this domain, storytelling is

mainly used in the initial sense of orally transferred stories to engage audiences beyond the ordinary exhibition or collection the institution is showing to the public. An example is a guide for museums to organize storytelling events from the London Museum Hub (Johnsson, 2006).

In recent years, cultural heritage institutions have also focused on storytelling as a form of user-generated content and interactions with digitized cultural heritage artifacts to provide a better contextualization: *"Cultural treasures that have been singled out for preservation - cherished over time, fought over, bartered, stolen, celebrated in verse - can have a singularly powerful and evocative presence. Properly structured, storytelling activities encourage people to connect to these artifacts on a deeper, more personal level, reaching an understanding that goes beyond the more traditional, intellectualized parameters established by museum professionals (historical, cultural, stylistic, and biographical)"* (Springer et al., 2004).

Offline, institutions often have years of experience in engaging the public in storytelling, which is particularly true for museums. Online, they need to translate their experiences into the digital world and understand the vehicles that drive successful digital storytelling. Only then, this activity can unfold its potential while creating rich access points to the material.

3.4.4. User Collections

User aggregated collections of cultural material gain a lot of attention in research and engagement practice. They are centered on a theme and should not be confused with aggregations of personal items like emails or photos that are often subsumed under the term 'personal collections' (e.g. Beagrie, 2005). As used in this thesis, user collections are a means of personalization that can help to provide more customized content to all audiences. As adaptive systems are more and more used in the cultural heritage domain, many services for personalization are introduced (Ardissono et al., 2012). User collections help users to customize their experience on a portal. They can be leveraged as an expression of the users' interest and a tool for participation and community building.

User collections are meant for the individual. Especially in libraries, there is a long tradition of providing the means to store retrieved books for future reference or for aggregating a list that can be used later. These user collections serve as bookmarks in library portals. Museums also experiment with this type of user interaction, especially to support learning and sustainability of a museum visit (Fantoni & Bowen, 2007). Marty points out that users are often highly motivated, express-

ing their interest in creating collections (Marty, 2008b). He also investigated user expectations when creating customized user collections on museum sites (Marty, 2011). Nevertheless, another study concluded that not many people create personal digital collections and when they do so, they seldom return to them (Marty, 2011). These studies are often very case-specific focusing on a particular museum (Marty, 2008b), archive (Krause & Yakel, 2007) or library (Gibbons, 2003) website or information system.

Cooper argues that people should be enabled to share their collections publicly as this would increase the value of the activity for the user (J. Cooper, 2006). Simon (2010, p. 20) delivers the same argument: for successful participation of users, institutions need to provide a functional feedback loop which values their contributions and lets them know how and when it will be used or displayed.

User collections are an interesting form of engagement as institutions can highly benefit from the regrouping of their material done by users. However, it seems that incentives for users are not often provided and some of these features have hardly any returning visitors. Reasons for that are manifold and not very well understood. One can speculate that cultural institutions are still struggling to determine their attitude towards user contributions of all kinds.

3.4.5. User-contributed Data - the Double-edged Sword

For memory institutions, the opportunity of engaging users and allowing their contributions is one not to be missed. Not only can it help to outsource some of the tasks that cannot be afforded in-house, but it also offers a possibility to interact with the general public and raise awareness of the institution and its collections. It is a tool to reach more people and encourage them to engage with content which forms the basis for their cultural values. Furthermore, comments, new contexts, ratings and personalization make cultural heritage content more accessible.

Metadata makes cultural heritage objects retrievable. Especially in museums and archives, metadata is traditionally created for easing internal workflows and the describing fields are often of no relevance for the general public (Vliet & Hekman, 2012). For example, to retrieve paintings from a museum, it is much more beneficial for most people to query for terms that describe the object rather than querying for an acquisition number. Museums would need to re-index all of their objects with keywords (some might have thesauri or other subject headings), which is too resource-intense. Outsourcing this to the public can engage new audiences while object descriptions get more understandable (Vliet & Hekman, 2012).

Furthermore, the public can add new forms of contextualization that are beneficial to memory institutions explaining the importance of objects in their historic context. When adding new facets to an object and grouping it in a new context, different aspects of this particular object are highlighted. Apart from social tagging, this can be achieved by letting users collaborate on collections of items; by inviting them to upload new items and group them within an already existing collection or allowing them to comment and share items.

Nevertheless, user engagement on such a level also bears fears, and not every institution is happy with the opportunity of user participation. Stakeholders assess the new opportunities differently. There is reluctance when implementing features that aim at harvesting user-contributed data. Many institutions are reluctant to do so for several reasons:

- they fear abuse of the systems,
- they do not know how to ensure the quality of the data provided by users,
- they do not have the knowledge to set up such a project,
- they lack IT knowledge to implement it, and
- they believe that user-generated metadata is generally of low quality.

The last point is mainly caused by a lack of strategy. Simon (2010, p. 21) states that the right incentive and an appropriate environment are needed to gain high quality contributions from users. Just offering a blank space without any context on what it will be used for and whether is acknowledged at all will result in "toilet-wall" remarks. Simon (2010, p. 22) says that meaningful participation is built on constrains. Users need to understand why their contribution is important and what it is used for. In addition, the users' efforts must be reflected in some sort of reputation system: the more and the better, the higher the users' reputation.

Often projects dealing with user-generated content protect their content from abuse through implemented barriers. The Living Museum[6], for example, an online application for students to create virtual exhibitions around Jewish heritage, restricts access and approves every user who wants to create an account. Furthermore, curators examine all user exhibitions to ensure they reach a certain qualitative threshold (Farber & Radensky, 2008).

[6] http://www.living-museum.org/ last accessed November 11, 2013.

The fear is that cultural objects may somehow lose their importance as carriers of cultural information when connected to other low quality content. This might actually be the case, especially when considering groupings of items that may transport wrong facts. In these cases, the community could self-control the content. To do this, there is a need for a healthy and well-established community with defined roles, which can also be explicitly assigned to users. This is coherent with the understanding that crowdsourcing and user contribution need to serve different people and their ability and desire to interact with a system.

It is generally assumed that providing a 'perfect' system will encourage users to happily donate their free time for a good cause. But not everyone likes to participate actively and so-called lurkers are just consuming (Y.-W. Lee et al., 2006). However, statistically visualizing the passive actions (like viewing, bookmarking and following people and objects) of lurkers can also have a positive impact on the content creators and motivate them to upload and generate more and better content.

How cultural institutions deal with user-contributed data and use it to engage users on the one hand and enrich their content on the other will be the key factor determining the success of their information systems. The systems will be judged by their ability to maintain a discourse involving experts and novice users about cultural material that excels in quality and relevance (Proctor, 2010). The crucial issue for cultural institutions is to find the balance between democratizing access and maintaining a curatorial role (Proctor, 2010).

3.5. Summary

This dissertation analyzes interactions in relation to the modes of access they allow and support. This new approach links the modes of access, *Search*, *Browse* and *Engage* to the interactions offered by a system. The access to information and cultural heritage content is influenced by the interactions offered by the system and their ability to create valuable access points. The interrelatedness between interactions and access modes is the subject of the coming chapters. Moreover, the implementation of these interactions in cultural heritage information system and the consequences for the different access forms will be studied. This new perspective will help to derive consequences for effective system design.

CHAPTER 4

Methodology

Studying information systems traditionally involves quantitative research methods, but the last few decades have seen an increasing use of qualitative research. In 1988, Kaplan and Duchon advocated a mixed method approach in information system research, providing an account of the weaknesses of a solely quantitative approach. Today, information systems are understood as holistic entities that can only successfully perform when the user's context is considered in the development and evaluation of the system. Therefore, mixed methods approaches that combine different views on the system are so effective and will be also used in this thesis.

4.1. Classifying and Evaluating Interactions

Since interactions in cultural heritage information systems are very complex impacting several other system components, a mixed method approach triangulating quantitative and qualitative content analysis, case study research and analytical evaluation was used. It complies with the complexity of interactions and was divided into three steps each representing different method for answering the research questions:

Step 1 - Case Study for Framework Development: An exploratory approach was taken to generate an overview of interactions occurring in cultural heritage systems. Through a grounded theory approach, a framework for classifying interactions was developed. For that, a sample of 50 cultural heritage information systems was analyzed regarding their interactions provided (for the

sample of systems, see appendix A). These interactions were grouped and a taxonomy of interactions emerged. Additionally, evolutionary stages of interactions were determined for each group linking them to engagement with and access to content. This formed two dimensions that together compose the framework for interactions. This framework enables the description of interactions enriched by indicators that express the value of these interactions for user engagement and access to content. It will be further described in chapter 5.

Step 2 - Qualitative and Quantitative Content Analysis: The framework was used for describing an extended sample of 72 cultural heritage information systems (see appendix C). The interactions occurring in the sample were coded and matched to their position in the framework. The result is a quantitative analysis of the frequency of interactions across different types of cultural heritage information systems and a deep understanding of the qualitative nature of these interactions. This will be described in chapter 6.

Step 3 - Analytical Evaluation: The third step is an analytical evaluation where the framework is used to assess the interactions in a given information system and their influence on it. From each group of information systems from the previous content analysis, one representative system was chosen. The systems selected for the evaluation were Europeana, Brooklyn Museum, British Library, History Pin, Nationaal Archief and The International Children's Digital Library (can be found in appendix C). The evaluation resulted in recommendations for interactions in cultural heritage information systems and guidelines on how to implement them for effective system design. This will be described in chapter 7.

The following sections describe the different steps, a justification for the chosen method and the respective data sampling strategies in more detail.

4.2. Case Study with Grounded Theory Approach

A case study is a method to derive conclusions and to slowly build a theory from observations. Lazar et al. (2010, p. 147) mentioned several key aspects that are characteristic of case studies in HCI usually observing one or more users performing computer tasks. These aspects can be applied to the scenario here as well and give a justification why this methodology was used:

Focus on a small number of cases: Here, the case study was paired with the data analysis approach of grounded theory. As many cases were analyzed as needed to emerge a theory. One reason for a slightly high number of cases is that the definition of a cultural heritage information system is very broad, so it is essential to look at different cases that might fall under this definition.

Context is embedded: Due to the lack of an in-depth categorization of interaction patterns in cultural heritage, the context of the information systems has to be considered. This also includes the purpose of the system and its characteristics.

Multiple data sources: Not only the cultural heritage information systems themselves are sources for the data analysis, but articles and user reviews might also be consulted. Especially research literature, blog posts and other forms of online communication come into play as they generate a vision of the way interactions with digital cultural heritage could develop. This knowledge is also used as input for the framework, which does not only reflect the present state but evolves into a vision of how future systems could look like.

Focus on qualitative data and analysis: The analysis is not focused on the statistical evaluation of certain patterns throughout different cultural heritage information systems but rather on a complete picture of applied patterns with a strong focus on extremes. It also applied principles of grounded theory that support the emergence of patterns from qualitative data.

The case study method has been used to identify patterns in information systems in previous work. For example, Organisciak (2010) developed a framework for the motivations of users on crowdsourcing sites. He conducted a case study and coded motivations to analyze them on 300 different websites. In the cultural heritage domain, Oomen and Aroyo (2011) created a taxonomy of crowdsourcing tasks. Their approach is not well described but they note that they *"have been gathering examples of crowdsourcing initiatives"* (Oomen & Aroyo, 2011, p. 141), which hints at the case study approach. Another study determining patterns in online search behavior stresses the usefulness of the case study approach. It also discusses various problems like biases and how to address them using this methodology (Fidel, 1984).

For data analysis, principles of grounded theory were applied. It is rooted in the social sciences developed to derive theory and meaning from large and heterogeneous amounts of data (often of qualitative nature). It was introduced in 1967 by

Glaser and Strauss[1]. Grounded theory is characterized by taking *"an iterative approach, constantly moving between data collection and analysis."* (Pickard, 2007, p. 158). Grounded theory in information system research is rare but can be found (e.g. Pandit, 1996). In this thesis, several steps of this data analysis approach were used (Lazar et al., 2010, p. 284):

1. Open coding: To the best of the author's knowledge, there is no theoretical framework that describes or groups interactions in cultural heritage information systems. Therefore, the author looked for emerging concepts or applied existing ones. For that, all interactions and collaborative features were aggregated, and their occurrences in the systems were listed.

2. Development of concepts: In this case, concepts are features, interaction patterns or access points for the data. For example, a concept was a "user account" or "RSS sharing".

3. Grouping concepts into categories: Firstly, a broad categorization revealed the grouping: *content representation*, *user representation* or *social features* (table B.2). Table B.3 in appendix B shows a summary of the open codes grouped by the three categories. From the accumulated set of interactions and interaction patterns, a taxonomy of interactions in cultural heritage information systems was derived.

4. Formation of a theory: The taxonomy revealed that interactions within a certain interaction class could differ in quality and scope. Furthermore, as shown in chapter 3, interactions are related to access. To describe this, a second dimension was added that reflects the degree of interactions within a given class. Together, the taxonomy of interactions and degree of each class form the *Framework for Interactions in Cultural Heritage Information Systems*.

Theoretical sampling was applied to collect cases as a basis for the analysis. Step 1 and 2 were repeated until saturation within the sample was reached. The 50 sampled cultural heritage information systems were briefly described and categorized according to their type and their country of origin (see appendix A).

[1]The authors have now differing opinions on how to analyze data with the grounded theory approach (described in Lazar et al., 2010; Pickard, 2007, p. 284, p. 156).

4.2.1. Sampling of Systems

A set of 50 cultural heritage information systems was selected for analysis (see appendix A for the complete list). The selection of cases followed the approach of theoretical sampling. Rather than choosing systems for statistical representation (probability sampling), this sampling wants to create theoretical classifications and welcomes extremes that can extend theories (Eisenhardt, 1989). The goal is to aggregate information systems that offer a wide variety of interactions with cultural heritage and have the potential to guide further developments in the field of interactions. Patton (2002, p. 230) calls these samples *"information-rich cases"*. The sample is grown by applying snowball sampling that takes into account new information that was revealed during research (Pickard, 2007, p. 64).

An initial set was collected by choosing systems that stand out in their way of presenting cultural heritage material, engaging the user, being maintained by a well-known authority or are popular for their design and interaction features. To aggregate this list, thematic mailing lists, conference websites as well as journals were scanned to retrieve systems that fit the requirements. The sampling was terminated when no new types of interactions for engaging with digital cultural heritage were detected.

4.2.2. Sample Characteristics

To describe the sample, the following section lists the formal main characteristics of the information systems.

Types of Systems and Country of Origin of Hosting Organization

Table 4.1 shows the types of systems occurring in this sample and their definitions. They are developed on the basis of the survey initiated by Online Computer Library Center (OCLC) on social metadata (Smith-Yoshimura & Shein, 2011, p. 69). The definition of museum, archive, library and community systems is influenced by this survey but adapted to the needs of this analysis; the other categories were created to acknowledge the characteristics of the systems in this sample. Most of the systems carry characteristics of several types and each system can be assigned to one or more groups.

The systems in the sample come from many different countries. Figure 4.1 shows the country where the hosting organization or institution is based.

Table 4.1.: Definitions of different system types and the number of systems per type (systems can belong to multiple types).

Type	Definition	Example	Count
Museum	System providing access to the resources of a museum.	http://www.louvre.fr/	23
Archive	System providing access to the resources of an archive.	http://www.oesta.gv.at/	8
Library	System providing access to the resources of a library.	http://www.bl.uk/	11
Aggregator	System offering a single access point to the resources of several institutions or organizations. Here the affiliation to a certain region or type of organization is the main characteristic.	http://www.europeana.eu/	11
Collection	System offering a single access point to cultural heritage resources that are united by a theme. Content can be contributed by one or more institutions.	http://www.artbabble.org/	16
Community	These systems are living from and for the content of the user and the community. They can be arranged around a theme or a specific region.	http://historypin.com	7

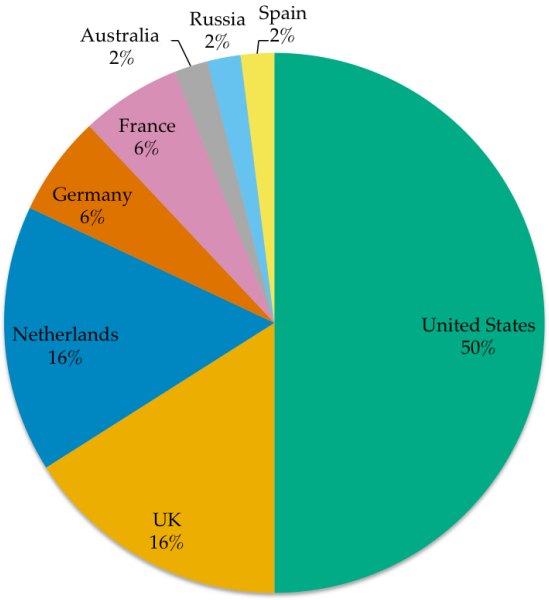

Figure 4.1.: Percentage of systems in the initial sample and their hosting institution per country of origin.

Types of Content

The analyzed systems provide different types of content. Table 4.2 summarizes the different types of content and their definitions. The systems host images, text, sound records, audiovisual content or a mix of them. These digital objects need to be distinguished from content that is constituted solely of metadata representations. Metadata representations can mainly be found in aggregators that do not store the digital objects, but only their metadata referring to the original objects at the providing institutions.

Another criterion in the sample is whether the content is user-driven or provided by an institution. Museums, for example, only provide their own material as they want to attract and engage potential visitors. On the other side, there are systems that treat content from institutions and content from users equally. Only a small number of systems follow the user-initiated approach, while the majority of systems presents institutional content.

Table 4.2.: Type of content in cultural heritage information systems and their definition.

Content type	Definition
Image	All content that is presented in the form of an image. These are digitized artifacts such as paintings but also images of sculptures and other cultural heritage objects.
Text	All content that is presented in text form and can be read online. Digitized full-texts fall into this category.
Sound	All content representing sounds like radio shows or interviews.
Video	All content represented as videos, for example videos of performances or interviews or TV shows.
UGC	User-generated Content: content uploaded by users. This only applies to systems that allow users to upload and control their cultural heritage objects.
Metadata records only	This applies to systems that do not host the actual objects but only references to them in the form of metadata records.

4.3. Qualitative and Quantitative Content Analysis

Using the established framework (described in detail in chapter 5), information systems were analyzed and compared with each other in a content analysis. In this second step, the sample of the information systems, which was used to establish the framework for interactions, was extended to make a more generalizable statement about interactions in cultural heritage information systems. The goal was to determine interactions that are prevailing in the domain across different systems and connect these with the access types offered for users.

The content analysis delivered quantitative data to determine the frequency of different interaction types in cultural heritage information systems enriched by qualitative data that provides information about the attributes of these interactions. This triangulation of data allows an in-depth analysis of interactions and their interplay with other components of an information system. This so-called concurrent triangulation strategy allows to merge the different data for interpretation (Creswell, 2009, p. 213). In this analysis, first the frequency of the occurring interactions was determined and then enriched by the qualitative attributes of

these interactions. The content analysis followed the path suggested by Neuendorf (2002) with small adjustments to answer the questions that were raised. The different steps that form the content analysis are listed below:

1. Creation of a codebook based on the framework for user interactions (see appendix D).
2. Creation of a coding form to code interactions of the sample (see appendix E).
3. Extension of existing sample to at least 10 information systems per type (see appendix C).
4. Revision and adaptation of codebook and coding form.
5. Coding of interactions (see appendix F).
6. Reporting (see chapter 6).

The codebook determined interactions per class and established one or more interactions that are representative for the degrees in each class. The tables D.1 - D.7 describe the interactions for each degree per interaction class and how it is coded (from 0-5). Based on this, the coding was performed with a coding from (see section E). The coding form ensured consistency and saved time. It was developed as a survey with multiple choices possible for each section. The seven sections related to the seven interactions classes. To evaluate a system, all interactions that applied per section were marked. This determined the degree of interaction for each class by using the highest code number per question. The degrees of interaction built upon another, so for the coding only the highest degree of interaction (corresponding to the highest number in the codebook) was used.

Content analysis usually deals with large amounts of text that are boiled down into several categories. These categories need to be as objective as possible, so that a high agreement is reached between different people annotating. Here, an analysis of the systems was conducted with the author marking the choices for each section. A high level of objectivity was ensured by the tasks in the code form. Finding interactions and matching them to the framework is a non-subjective task because it is based on the interactions possible on a given system. An interaction pattern is either provided by a system or it is missing. Both variants (an interaction being there or not) result in a different position in the framework. The matching of the answers to the framework is detailed in the codebook (appendix D). The seven section with the choices for each system are in the code form (appendix E). Using

these tools, information systems and their offered interactions can be categorized with the developed framework to build an evaluation tool which can be used by institutions to assess their web-based information systems and evaluate whether they conform to their initial plans.

Results report the prevailing interactions for the six system types described in table 4.1 and what it means for developing access and purposeful interactions with digital cultural heritage material. A reporting of the results can be found in chapter 6, the raw data of the analysis is in appendix F.

Extending the Sample Set

Many cultural heritage information systems miss user interaction features or hide them behind an institutional wall. Therefore, it is important to analyze what the trailblazers of the field are offering; for this reason, many large and well-known systems are represented in the sample. The sample chosen for the content analysis is non-representative as it was created through theoretical sampling. Nevertheless, traffic to these systems covers a big part of the traffic sent to cultural heritage information systems worldwide. The initial sample was extended to include more cases per system type and incorporate the systems that are most popular in terms of reputation of the hosting institution and amount of online visitors (appendix C). For each category, where applicable, ranked lists were examined and overlaps added to the sample. For example, the top 10 museums from three different lists of the most visited museums in the world were extracted. When the museum was found in more than one list, it was added to the museum sample. In the museum sector, it was fairly easy to aggregate lists that reflect online visits worldwide. For the library and archives domain, statistics on an international level do not exist as umbrella organizations mainly work on a national or regional level. In this case, large representatives of each given type of a system were chosen. Table 4.3 shows the initial sample compared to the extended one.

Two sites from the initial sample were dropped and excluded from the extended sample. Mapping our Anzacs[2] was in a transition phase at the time of evaluation and did not offer all functionality. The ShelfLife DPLA Demo[3] was excluded as it only served as a demonstration and is not considered an information system.

Figure 4.2 shows a pie chart of the countries that host the systems from the extended sample. Again, information systems can belong to more than one group.

[2]http://mappingouranzacs.naa.gov.au/ last accessed November 8, 2013.
[3]http://librarylab.law.harvard.edu/dpla/demo/app/ last accessed November 8, 2013.

Table 4.3.: System types of both samples and their frequency.

System type	Number of systems in initial sample	Number of systems in extended sample
Museum	23	34
Archive	8	15
Library	11	18
Aggregator	11	12
Collection	16	15
Community	7	10

For example, the *Museums* group has 34 systems, 21 of them carry only characteristics of a museum. Six of the systems were additionally grouped as being *Collection* systems, another five as being *Community* systems and four systems have characteristics of *Aggregators*. In the whole group, there are two systems that were grouped in three different groups, one system in the *Museum*, *Collection* and *Community* groups, the other one in the *Museum*, *Collection* and *Aggregator* groups. All groups with their systems and the assigned type of the system can be found in appendix C.

4.4. Analytical Evaluation

The content analysis shows how the framework can be used to find characteristics within a given group of systems. In chapter 7, the framework will be used for an analytical evaluation. This is a method often applied in HCI and usability testing of systems. Two methods are predominant here, inspections such as heuristic walkthroughs (Nielsen & Molich, 1990) or evaluations based on theoretical models (Rogers et al., 2007, p. 592). The latter approach tries to make assumptions about the performance of a given system in various different tasks (Rogers et al., 2007, p. 706). The developed framework for interactions fits in this category. It evaluates the function of an interaction or a group of interactions with regard to the ability of broadening access and engaging the user. Here, six information systems were evaluated with the framework to further explain the results obtained for these particular sites. The goal was a list of problems or challenges for each information system with regard to interactions and their ability to promote access to cultural

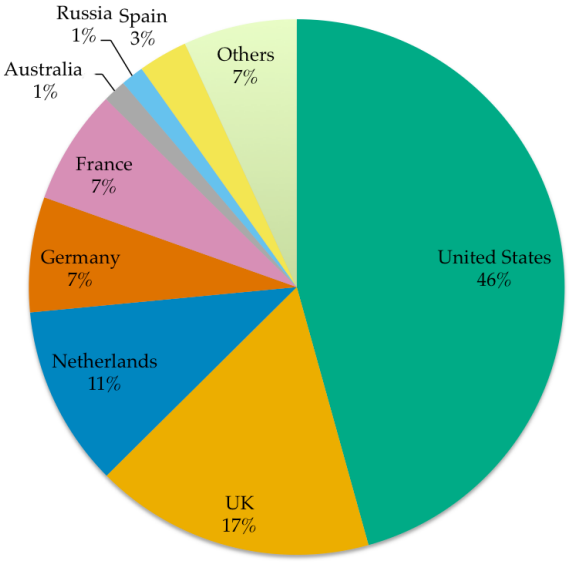

Figure 4.2.: Percentage of systems in the extended sample and their hosting institution per country of origin.

material. To represent the evaluation, the position of each information system in the framework was visualized in radar graphs giving a holistic overview on the interaction implementation in this system. This enabled a graphical approach to compare different systems and reveal their strengths and weaknesses at a glance.

The result of this study is a very detailed roadmap on how to improve the information system at hand to provide more meaningful interactions and thus increase the accessibility of the digital cultural heritage material (chapter 7).

4.5. Summary

Figure 4.3 shows an overview of all methods used in this thesis and how they answer the research questions (icon: question mark). It lists the data used (icon: information), and the results obtained through the different analyses (icon: check mark). This dissertation looks for relationships between user interactions and access to and engagement with digital cultural heritage. To understand interactions and their influence on other system components in cultural heritage information systems, a framework for interactions was established. It was then used to evaluate and im-

prove interactions and understand their interplay with the access components. The purpose of the interactions was identified with a qualitative approach. The aim was to get a deeper understanding of interactions in cultural heritage information systems and why some of them do not reach the level of engagement one might have hoped for.

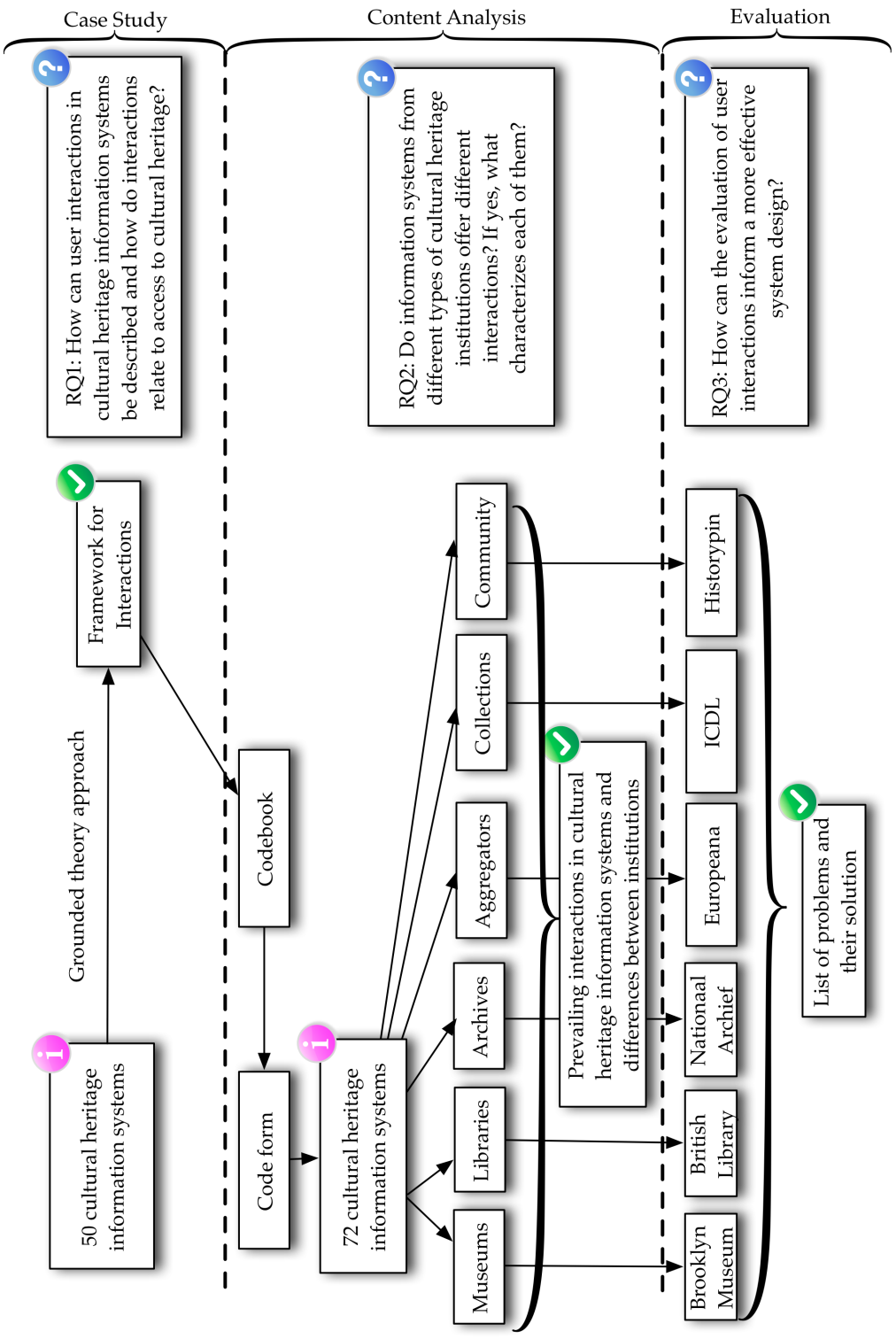

Figure 4.3.: Overview of methods used throughout the thesis for answering research questions and their results.

CHAPTER 5

From Curation to Collaboration - A Framework for Interactions

In this section, a framework is developed that reflects the structure of interactions in cultural heritage information systems and relates them to different access modes[1]. The framework is based on the interaction features and interaction patterns that were found in a sample of 50 cultural heritage information systems. It describes users' interactions with cultural heritage objects and their level of engagement. Not only does it reflect the existing interactions in cultural heritage information systems but it also gives an outlook on further developments and how these systems could evolve in future.

The framework consists of two dimensions. The first dimension is the taxonomy that allows all user interactions within the system to be systematized into different interaction classes. The second dimension describes the complexity within a class and helps to understand the level of engagement for certain sets of interactions. The framework is a holistic approach to evaluate interactions and their ability to serve users and institutions alike.

[1] An early version of the framework was published here: Stiller, J. (2012). A framework for classifying interactions in cultural heritage information systems. International Journal of Heritage in the Digital Era: Proceedings of EUROMED 2012: Progress in Cultural Heritage Preservation, 1(Supplement 1), 141-146.

5.1. Interaction Taxonomy

In a first step, a classification of the different interactions and interaction patterns found in the sample information systems is developed. By analyzing these interactions, different classes of interactions emerged.

An interaction is defined as any movement of a user within a system leaving a trace, like clicking on an item or entering a search term. A subsequent series of interactions are interaction patterns, such as logging into an account or the search process in its entirety. These patterns are clustered into different classes depending on which task they are fulfilling. The classes grouped into meta-classes form the first dimension of the framework creating a taxonomy of common interaction patterns in cultural heritage information systems:

Content interaction meta-class: The content is the basis of an information system and guides its design and functionalities. In cultural heritage information systems, either the institution or the user provides content. Interactions with content target experiencing and discovering it through search or browse, deep-zooming into pictures or paging through a curated online exhibition. The content's origin is often shaping the interactions offered with it. To the *Content* meta-class belong the *Institutional Objects* and *User Objects* class.

Curation interaction meta-class: Curation can be institutional or applied by the user. Institutional curation is often applied prior to feeding the objects into the information systems, e.g. through acquisition of an object so that users can interact with the results, such as curated exhibitions. Interactions with institutional curation fall under the *Content* interaction classes. The user-driven curation interactions are characterized by the customized and personalized way in which the user can experience the digital cultural heritage material. Here, the goal is to involve users on the one hand and to contextualize the digital material by engaging a user or a group of like-minded people on the other. In this meta-class, one can find the *Annotations*, *User Exhibitions* and *Storytelling* classes.

Support interaction meta-class: To offer meaningful and sustainable systems with a rich user experience, some supporting interactions are necessary. They revolve around user management and user identities and as they are not regarded as essential for an information system, they are often neglected. They invite the user to stay on the particular site and identify with its content. The

Support classes take the *Curation* classes to the next level, engaging the user and providing incentives to contribute and revisit. These interactions make the experience in a cultural heritage information system meaningful and sustainable. Example interaction patterns are creating and editing user profiles and following other users. The *Support* interaction meta-class consists of the *User Representation* class and the *User & Content Reputation* class.

The interaction meta-classes described above are interrelated. *Curation* is not possible without user management (*Support*), and the *Content* is just a lifeless structure without any activities targeted on interacting with it (*Curation*). Table 5.1 shows the taxonomy of interactions with a detailed description of every class.

These classes are constructs and naturally, interactions might fall into more than one category. To provide the user with certain functionalities, combinations of interactions coming from more than one class are the rule. For example, to offer *User Exhibitions*, which are grouped under the *Curation* meta-class, a place to store the user-generated links between the objects needs to be identified. In most cases, this is the user account that also allows for editing and revising the exhibitions. Creating such an account falls under the *Support* meta-class. In this framework, the simplification was chosen to question interactions and their purpose and evaluate them from a different perspective. Interactions generally span several classes to form a meaningful workflow, e.g. the *Support* class enables the *Curation* interactions to be more purposeful with a high impact on the underlying source data (*Content*) increasing quality and discovery of these resources.

Within an interaction class, there are several options how to implement a certain feature, e.g. a social tagging functionality (class: *Annotations*). Not all of these options prove to be useful, so a means to express the complexity and quality of the interaction within a class is required. Furthermore, the link between interactions and access to content needs to be established. Therefore, a second dimension is added to the taxonomy, which can describe the degree and quality of the interaction of a certain class and connects it to the modes of access.

5.2. Interaction Degree and its Relationship to Access

The classification of interactions reveals purpose and interplay of interactions. But it lacks an essential ingredient that fuels the interactions and determines how sustainable and useful an offered interaction is and how it relates to the access modes. From the interaction classes alone, one cannot evaluate the implications and de-

Table 5.1.: Classes of the interaction taxonomy with descriptions of the interaction patterns.

Meta-class	**Class**	**Description of the interaction patterns**
Content	Institutional Objects	Interaction patterns related to the institutional content aggregated in information systems. Examples are searching full-text, looking at a full-view item or browsing thematic exhibitions.
	User Objects	Same as above, but the content is user-provided, therefore different functionalities need to be applied. Often, this means that the system needs to provide an upload functionality and processes to maintain the material contributed by users.
Curation	Annotations	Interaction patterns that allow users to add additional information to content, such as writing comments or other free text. It also includes the linking of other digital objects to existing content.
	User Exhibitions	Interaction patterns that allow users to curate customized exhibitions and aggregate collections of items.
	Storytelling	Interaction patterns that allow users to add their own point of view through directed and chronological narration.
Support	User Representation	Interaction patterns that let users represent themselves and connect with each other, e.g. creating user profiles and following other users' contributions across the system. Depending on the implemented *Curation* class, this can have different implications.
	User & Content Reputation	Interaction patterns that present the reputation of content and users alike. This implies rating and starring favorite objects, but also leadership boards.

pendencies for improving access to cultural heritage content. Tasks such as adding a tag to a resource can be implemented in different ways, and it is often not obvious what impact different implementations have. Small changes in scope and complexity of offered features influence the modes of access systems provide users to satisfy their information needs. For example, it makes a difference whether a tag is visible on the full view page of the object that was tagged or whether the tag is hidden in the user's account. In the first case, the tag can be searched and browsed; in the latter the tag is invisible to other users and therefore does not act as an access point. In one information system, interactions of the *Annotations* class might stimulate social collaboration among users; in another, social tagging is not more than a saved list of bookmarks. To distinguish between these different degrees of interactions within a class, a second dimension is introduced that assesses the degree and complexity of interactions and their potential to create new access points to the material.

For interactions to become purposeful, they need to attract users to participate and revisit the system, in the best case broadening the access to the offered material. The degree as to how interactions achieve this can be expressed on a scale, illustrating the second dimension of the framework. These degrees of interactions can be considered as development stages, where each stage builds upon the preceding one. On each stage, the interactions become more complex, but also more purposeful, creating more access points for the material the user is interacting with. In general, institutions should strive for a higher degree of interactions as it grants more purpose to their interactions while creating more access points to the material. Figure 5.1 shows a model of the interaction degrees and their influence on shaping different access points in the *Search*, *Browse* and *Engage* modes. In general, the more complex and user-oriented an information system is, the more interaction features it offers.

Driven by the complexity of interactions, five development stages can be identified that comply with a scale of ordinal values (1-5) as seen in tables 5.2 to 5.6. The different degrees of interactions are interwoven with the access modes offered to the material. The higher the degree of interaction, the higher the complexity of the possible interaction patterns and the amount of access points created. On the first degree, *Basic Functionality*, there is only a certain feature implemented, which might allow the user to search the underlying data. This level does not use any structure the data might have. The next level, *Organization*, leverages this structure, and browsing and searching can take place. This is increased with the *Enrichment* level

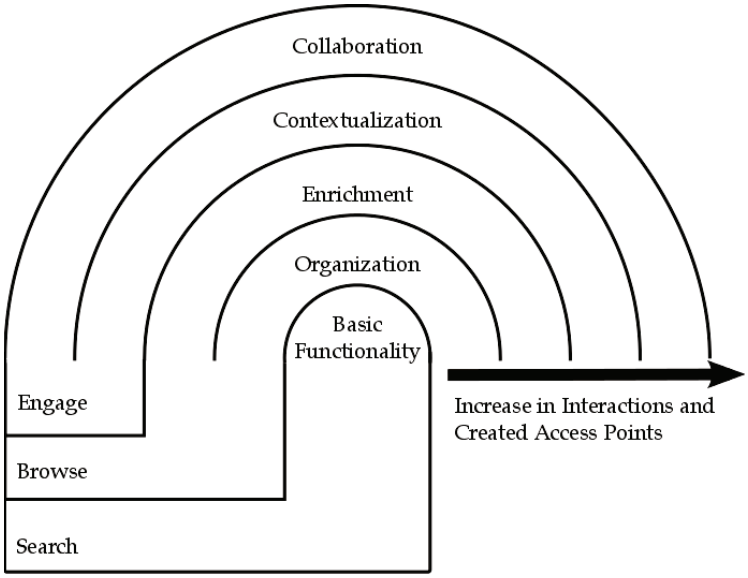

Figure 5.1.: Second dimension of the framework in relation to different access modes.

that adds another layer of information to the underlying source data leading to better browsing functionalities and better search. The last two levels *Contextualization* and *Collaboration* allow *Engage* access points which come from users participating and collaborating in groups or alone in activities around digital heritage objects.

Table 5.2.: Degree of *Basic Functionality*, its access mode, value and description.

Basic Functionality	
Access mode: Search	Value: 1
For the *Content* classes, this degree is characterized by textual search as the most basic form of accessing content; in many cases in form of a simple search box. For the *Curation* classes, it means the basic module of a given feature is provided. For example, in the *Annotations* class, the user can add a tag or a comment. How this user addition is used and processed in the system is not part of this stage. For the *Support* classes, basic features for user representation, such as an account or rating objects are present. On this level, some structure might exist but it is not used.	

Table 5.3.: Degree of *Organization*, its access mode, value and description.

Organization	
Access mode: Search & Browse	Value: 2
This degree enables more complex interaction patterns. In the *Content* classes, this means to adhere to best practices in metadata standards such as the use of rich, domain-specific data models (e.g. CIDOC Conceptual Reference Model (CRM) or the EDM). An example of the benefits of more structured metadata is the provision of faceted search filters to reduce the number of results for a query. In the *Curation* classes, it means that curated content is stored in a structured way, thus allowing simple browsing and content exploration beyond search. For the *Support* classes, this often means that representation and reputation are made visible, creating recommendations for other users.	

Table 5.4.: Degree of *Enrichment*, its access mode, value and description.

Enrichment	
Access mode: Search & Browse	Value: 3
Enrichment provides users with more entry points for retrieving and exploring particular content. It enables targeted browsing and search as ambiguous terms can be differentiated and named entities and the like identified. For the *Content* classes, it can mean the provision of semantic enrichment within the metadata. In the *Curation* classes, any form of additional semantic information that is added to the content and therefore enables richer browsing and searching experiences. In the *Support* classes, enrichment adds an additional layer of complexity which might be reached through the transparent exposure of user-object-relationships.	

Table 5.5.: Degree of *Contextualization*, its access mode, value and description.

Contextualization	
Access mode: Search & Browse & Engage	Value: 4
With *Contextualization*, the engage access mode is activated, as *Contextualization* can be a product of links between users and resources. The content gets embedded into richer and more diverse contexts. In the *Content* classes, this means that users contextualize cultural heritage objects and add their meaning and interpretations drawn from a number of different sources, also external ones, to them. In the *Curation* classes, the product of the interaction can be contextualized with linked data from third party sources. Users can embed their tags, exhibitions or uploaded objects into a broader context by adding them to a map or grouping them by different viewpoints. For the *Support* classes, *Contextualization* often means the creation of further pivot points for grouping data. At this stage, workflows become very complex and possible interactions increase. They get intermixed with the need to set the right incentive for the user to participate. The technical implications for implementing contextualization are manifold; user-generated content needs to be stored, upload functionalities provided and a quality assurance deployed. Cultural heritage information systems rarely offer *Contextualization* through user-driven data.	

Table 5.6.: Degree of *Collaboration*, its access mode, value and description.

Collaboration	
Access mode: Search & Browse & Engage	Value: 5
The most complex degree of an interaction class is *Collaboration*. The focus is on working together in groups of like-minded people and sharing the product of the experience with a broader audience. For the *Content* classes, *Collaboration* means working together on activities related to institutional or user objects. To implement this, complex group functionalities and rights management need to be set up. Furthermore, getting users to interact with each other requires multifaceted user management and representation features. The *Curation* classes at this level are characterized by a social and collaborative effort in, for example, creating user exhibitions in groups. The *Support* classes assist the collaborative activities through simplifying communication and updates, e.g. features to follow other users.	

5.3. The Framework for Interactions

The combined dimensions presented above form a framework for interactions in cultural heritage information systems. It allows classifying interaction patterns by their goal within the system. Additionally, each interaction class can be complemented by a measurement of its degree and complexity linking it to access modes. Through interactions, access points are created. In general, interactions should focus on being purposeful for the institution and its users. The framework ties each interaction in an information system to a point in a grid, making clear what kind of purpose it is following. It helps to provide a means by which interactions can be described and compared easily. In the following sections, the classes of interactions with their complexity level and relationship to access modes are described in more detail.

5.3.1. The Content Classes

The *Content* classes are divided into the classes *Institutional Objects* and *User Objects*. Content in cultural heritage information systems is often provided by an authority institution but can be also contributed by users. Most of the time, digital cultural heritage content is just the published information from a collection management system of an institution that is not meant to be for public use and full of internal vocabulary. To ease access to the material, institutions often curate online exhibitions

around interesting topics, highlight objects on the homepage and curate browsing tools so users can discover objects they might not be aware of. This institutional curation leads to certain interactions on the user side. Users browse thematic online exhibitions and might learn more about a particular item in a carefully crafted virtual tour. All these interactions are important and increase the interest and experience of a user on a given site.

Due to the sheer volume of cultural heritage material it is self-evident that a reprocessing of data cannot be undertaken only by professionals, as it is too cost-intensive and tedious. User interactions with digital cultural heritage should not just be a pastime but meaningful and worthwhile for the institution and the user alike. Valuing the users' input as curatorial work would lead to more participation and better contributions. The user interacts with content to which the institutions or domain experts want to draw attention to and which was mainly chosen for its significance. This includes all work cultural heritage experts have put into creating the metadata and describing the digital objects.

In the *Content classes*, interactions are focused on the material and how to find, browse and experience it. The origin of this material, either coming from an institution or from a user shapes the interactions offered.

Institutional Objects

Cultural heritage objects are the backbone of a digital library. Accessing them is the crucial interaction the system should accomplish. At the *Basic Functionality* level within this interaction class, there is the search interface that offers access to documents by matching queries to the metadata descriptions of the text and retrieving the item with most relevance. Some sort of structure and organization of the source material might form this material, but it is not used at this stage.

On the *Organization* level, source data gets more structured allowing the user to search within specific fields and refine search results based on facets.

The next level, *Enrichment*, is reached when the content is supplemented with information like biographies of creators or other information sources. In general, it is the interlinking of information and the consequential enrichment of the source data with additional information that enhances browsing and search functionalities. It also includes curated information produced by professionals, such as virtual exhibitions. Domain-specific vocabularies can also be added to metadata fields to increase the ability to retrieve items across languages and find related material. Furthermore, *Enrichment* encompasses any added technology that enhances

the digitized material to let users explore it further, e.g. deep-zoom functionalities.

Contextualization takes this a bit further, it adds context to the material, which goes beyond the simple matching of terms to external dictionaries, word reference lists or other resources that add an outside perspective to the material. Characteristic of this level is the added external context that increases the scope of the original source data. It adds new perspectives and lets the items appear in a different light.

At the *Collaboration* stage, the most complex interaction patterns can be found. In this class, interactions are related to crowdsourcing or collaborative features that enable the improvement of cultural objects through groups of people with similar interests.

User Objects

Interactions dealing with *User Objects* in the form of digitized pictures, documents or audiovisual material uploaded by the user are similar to the ones of the *Institutional Objects* interaction class. The difference is the provenance of the source material but the same degrees of complexity can and should be applied to them. Therefore, it is unlikely that a system reaches a higher degree in the *User Objects* class than in the *Institutional Object* class. If both types of objects are allowed in a system they are either treated equally or the user objects reach lower degrees of interaction as they are detached from the initial content. User objects are not yet part of the cultural heritage canon and are therefore often ignored by hosting institutions. This is hard to change as many memory institutions still struggle with balancing user-generated content and their highly curated content.

5.3.2. The Curation Classes

The *Curation* classes focus on highlighting and interpreting the provided material from the users' point of view.

Annotations

The *Annotations* class clusters all interactions around user input. It can be a commenting or tagging functionality or any other user-driven data input. On the *Basic Functionality* level, this class comprises interactions with comment and annotation features that are mainly directed to allow users to give feedback on a particular item. Then, *Organization* lets users structure free-text fields, allowing the distinction between a comment or a reply to another user. *Enrichment* can be undertaken automatically or manually by extracted named entities and by structuring annota-

tions. *Contextualization* embeds annotations into already implemented structures of the systems and allows the grouping of annotations, making interconnections with other annotated items. Versioning control is a functionality that leads to more interaction on the user side and can help the institution to reconstruct the editing process and see which annotation was added by which user. *Collaboration* culminates into crowd-sourced curation and enhancement of metadata within user groups. An important group of interactions within the *Annotations* class is social tagging.

User Exhibitions

User exhibitions play a major role in engaging the public with digital cultural heritage material. On the most basic level, the *User Exhibitions* class provides interactions that allow users to store, bookmark or save objects, based on their preferences. This could also mean that searches can be saved for later references. The next level, *Organization*, allows the user to structure the saved content and make it visible to the public or certain user groups. Consequently, these user-generated exhibitions can be browsed and searched by others. One common characteristic is the differentiation of this so-called user content from professionally curated exhibitions. Interactions with those fall in the *Institutional Objects* class as the interaction is predetermined by the institution and does not engage the user to contribute. This separation is often applied because cultural professionals fear to get their content mixed up with rather trivial or, in the worst case, incorrect material. The *Enrichment* level allows for enhancement of the content with external or internal resources, vocabularies and objects. On the *Contextualization* level, exhibitions are thematically arranged within the greater context. This can make them retrievable or browseable based on the objects they describe or the topic they belong to. *Collaboration* in this class also refers to groups working together in creating exhibitions and sharing them.

Storytelling

Storytelling is an educational tool to impart knowledge and teach users; therefore it is a much-discussed feature in cultural heritage digital libraries (Robin, 2008). Storytelling is a means to make artifacts significant by exploring their value and determining their place within a given cultural collection. Telling these stories is essential to determine the significance of an object or a set of artifacts for a user or a user group.

On the first level of the *Storytelling* class, the *Basic Functionality* enables the user

to tell a chronological narrative. This includes any functionality that allows combining resources and text into a sequential storyline. Additionally, storytelling is always publishable and sharable as its purpose is to transport a message. If the story and the entities it is composed of are structured in such a way that the position of the story parts are stored and retrievable, the *Organization* level is reached. If the story can be enriched with external or internal resources, interactions in the *Storytelling* class belong to the *Enrichment* level. *Contextualization* is the ability to connect the story to the greater context and make it retrievable according to certain themes or time periods. The next level, *Collaboration*, provides interactions that let the users work together on stories and share them amongst each other.

5.3.3. The Support Classes

The *Support* interaction classes fuel the *Curation* and *Content* classes. They are the glue between content and curation and only with them meaningful interactions can be implemented.

User Representation

User Representation allows users to create their profile and interact with other users, giving them the possibility to present themselves and become part of the system's community. The more the implementation pursues collaboration, the more sustainable and valuable the information system becomes, and the more effective the interactions from the other classes will be.

On the *Basic Functionality* level, the provision of a user account allows the users to register and set a user name and password and, in a private area of the website, set customized preferences. In the *Organization* stage, there is a list of users that are public and can be browsed by their user name or other characteristics. This implies that users are able to switch their account from being private to publicly available. On the *Enrichment* level, the information system offers a public profile for users to represent themselves and list some of their characteristics that are relevant to the content of that system. The next step (*Contextualization*) offers an association of the users with their actions on the particular site. This means that other users can see what a particular user might have liked, commented, uploaded or described, which allows others to tie the user and the content they interacted with to the greater context of the website. The user becomes a resource or a link that connects all the parts of the website and therefore enhances browsing. On the *Collaboration* level, users are able to interact with each other. The system's main focus is the social compo-

nent, and users can chat and follow each other. This is the characteristic of a social network with all its facets. It also offers all functionalities to collaborate on certain curatorial tasks, stay informed about the progress and publish results.

User & Content Reputation

The second class that belongs to the *Support* interactions is *User & Content Reputation*. This group combines the interactions that support reputation of users and content alike. On the first level, *Basic Functionality*, there are interactions that allow starring or liking of objects or other resources. Many systems include this functionality on the full-view page of their objects. On the *Organization* stage, this information is aggregated and used either to highlight favorite objects from the collections or to offer ranked lists of the most liked artifacts. If this is enriched with statistics or graphics on which content is liked the most, the next level, *Enrichment*, is reached. On the *Contextualization* level, this is connected to user and content that allows to identify highly reputable users and their history, showing why they reached a particular level of expertise within a system. On the *Collaboration level*, high performers can work together, and there is, for example, a system in place that allows them to collaborate and curate content.

5.4. The Framework in a Matrix

In this section, the framework is presented in its entirety. It shows the characteristics of each class on its different degree levels. Depending on the implementation, different interactions are possible in one class per degree, but they share the same characteristics and requirements. For example, the interaction class *Annotations* can have different interactions depending on the system. One might have implemented commenting, the other social tagging. However, on each level, the interactions of commenting and the social tagging interactions share the same characteristics. Tables 5.7, 5.8 and 5.9 show the framework in a matrix. Each table represent one meta-class showing each interaction class with their respective interactions per degree. The tables highlight interaction patterns the information system is offering on each degree per class. The matrix is the basis for the development of the codebook that will be used to further describe interactions in cultural heritage information systems (see appendix D).

The strength of this framework is its simplicity. In general, the framework describes user interactions and how they relate to accessing the cultural material.

Table 5.7.: Matrix of possible interactions per degree in the *Content* classes.

Classes	Basic Function.	Organization	Enrichment	Contextualization	Collaboration
Institutional Objects	Users search for cultural heritage objects.	Users refine the search result with facets or filters.	Users deep zoom into the objects, users view virtual exhibitions curated by professionals.	Users follow links to more information on Wikipedia or other external resources.	Users change the objects' metadata and add additional information to it.
User Objects	Users can upload objects and search for their own uploaded material.	Users add descriptions to their uploaded material.	Users add links to their objects.	Users can embed other material from external resources, like videos or such, with the uploaded objects.	Users change metadata of other users' objects and add additional information to it.

Table 5.8.: Matrix of possible interactions per degree in the *Curation* classes.

Classes	Basic Function.	Organization	Enrichment	Contextualization	Collaboration
Annotations	Users add a tag to an object, users add comments or other text to an object.	Users search for annotations they added, users find resources based on tags assigned by other users.	User-tag-resource relationship is marginally exploited.	User-tag-resource relationship is fully exploited.	Users delete or edit tags other people added.
User Exhibitions	Users save or bookmark objects to a list or similar.	Users reorder the saved or bookmarked items, users publish their exhibitions.	Users add descriptions to the exhibition or the different items in it.	User add links or resources from third-party sites.	Users add additional information to exhibitions of other users.
Storytelling	Users tell stories about objects on the site.	Users reorder items and define a title for their stories.	Users add descriptions to the stories or the items in it.	Users use maps and timelines for stories and add videos or other pictures, users upload their objects and add them to story.	Users change the stories of other users.

Table 5.9.: Matrix of possible interactions per degree in the *Support* classes.

Classes	Basic Function.	Organization	Enrichment	Contextualization	Collaboration
User Representation	Users log into their accounts, users change settings or upload a profile picture.	User profile is publicly visible, users search for other user names.	On object page, users see if other users interacted with it.	Users see other users' action on their profiles, users follow activities of other users in a stream.	Users invite other people to a group for collaboration.
User & Content Reputation	Users vote for objects or favorite them	Users see how often objects are liked.	Users see the objects other users voted for, on each object users see who voted for it.	Leader boards or badges for active users, featuring popular objects.	Users reach privileges, like more editing rights, if contributing well to the site, other users rate contributions.

Users are taking several roles when interacting with the material. Active users might contribute material, opinions or comments while others act more as consumers searching for material. In the framework, there is no distinction between the different active types of users and their interactions. The fraction of contributing and heavily engaging users is small compared to the ones just consuming content in whatever form it is delivered. Nevertheless, the active users improve the overall quality of the systems for users who only consume.

The framework maps interactions and does not make any assumptions about the underlying technology needed. In the advanced degrees of the interaction classes, many interactions require user and rights management in order to be meaningful, which creates a need for sophisticated technological development that might not be feasible for all cultural heritage information systems. For example, at the level of *Collaboration* in all interaction classes, users are working together in groups. To implement this successfully, tools for collaborative editing, chat functionality and version control would be desired. Each of these tools come with their own interactions. Listing all these would have been tedious while the benefits of it are rather small. To serve a simple framework, interactions were noted that can represent a series of other detailed interactions.

The framework is an artificial construct that simplifies patterns found in the implementation of interactions in cultural heritage information systems. Therefore, not every level of an interaction class resolves into an easily identifiable interaction. Some levels are expressed rather by something users see than by what they can act upon. For example, in the class *User and Content Reputation*, the user may like an object on the first level (*Basic Functionality*). The next level, *Organization*, is characterized by the system's ability to count these likes and make them visible. For users, this is valuable information that might influence their behavior. The likes of others are visible and could motivate other users to like an object, too. The visibility of the number of people liking an object does not need to result in an interaction on the user side, but needs to be distinguished from the possibility of just liking an object which is not visible to other users.

5.5. Summary

This chapter was set out to answer the research question how user interactions in cultural heritage information systems can be characterized and how they relate to access to cultural material. For that, the framework for interactions in cultural heritage information systems was developed. It classifies all interactions into one of the three meta-classes: interactions with the content (*Content* classes), curating the content (*Curation* classes) or supporting the curation (*Support* classes). These different meta-classes are further divided into the following classes:

Content classes: Institutional Objects, User Objects

Curation classes: User Exhibitions, Annotations, Storytelling

Support classes: User & Content Reputation, User Representation

A second dimension of the framework consists of the following stages that are built upon each other:

> Basic Functionality > Organization > Enrichment > Contextualization > Collaboration.

These degrees are linked to the access modes *Search*, *Browse* and *Engage*. *Search* requires the least amount of interactions but occurs in all degrees, *Browse* is more complex and can be executed from the *Organization* degree onwards. *Engage* as an access mode only happens in the degrees *Contextalization* and *Collaboration*, this mode creates further access points which can then again be searched and browsed. With the establishment of the framework, the domain of cultural heritage information systems can be be further explored and described. The framework can serve as a tool to better understand prevailing interactions in cultural heritage information systems and their relationship to access to the material.

In the following section, the framework will be used to describe interactions in different groups of cultural heritage information systems. Patterns will emerge that further characterize these different systems and show their focus with regard to providing interactions with cultural material.

CHAPTER 6

Analyzing Interactions in Cultural Heritage Information Systems

In this chapter, the framework is used as a basis for describing interactions in cultural heritage information systems. To do this, interactions of a sample of 72 cultural heritage information systems were matched to the framework to analyze their purpose and the relation to the access points provided by the system. This content analysis compared systems by grouping them by their institutional type and other characteristics (as described in table 4.1, p. 72). It analyzed, for example, whether library information systems offer different interactions than museum information systems. Representing cultural heritage information systems in the framework helps to understand the usage of interactions in different system types. Thus, this content analysis will identify characteristic interactions for each system type and it will reveal challenges different institutions are facing when providing access to and interactions with their digital material. Detecting gaps between the desired outcome and the implementation of an interaction is critical in order to provide users with purposeful interactions that serve their needs.

6.1. Representing Interactions and their Degree

For a visual representation, the framework and its two dimensions are reflected in a radar model (figure 6.1). The edges with the radial lines of the radar graph represent the interaction classes whereas the different rings reflect the complexity and degree of interaction. With each outgoing ring from the center to the edge of the

graph, the degree of interaction develops from *Basic Functionality* to *Collaboration*. The further away an interaction class is from the central point, the closer it is to support *Collaboration*, i.e. the largest degree of interaction a system can provide. Wider rings correspond to more access points, which are created with more complex interactions. Each interaction leaves a trace in the information system successive users can follow to discover content. The more the interaction is implemented towards *Collaboration*, the more access points are produced. Interactions of an information system can be positioned on this grid to easily identify the nature of its interaction strategy and to draw conclusions about the access modes provided.

For a numeric representation, the degrees of each interaction class can be reflected on an ordinal scale ranging from *Basic Functionality* to *Collaboration*. This ranked order can be expressed in numbers from 1-5 where *Basic Functionality* takes the lowest rank (1) and *Collaboration* the highest (5) (see table 6.1). By calculating the median of the interaction degrees as measure for the central tendency, groups of information systems and their interaction classes can be compared. Thus, the degree of one interaction class of a group of systems can be compared to the same class of a different group. The median was preferred over the mean as the degrees of interactions are ordinal variables and the distance between the ranks is not known. Additionally, the median is not as much affected by outliers than the mean. To calculate the central tendency, only systems with interactions within that class were considered, the ones with no interactions were not taken into account for the analysis in this chapter. For example, a group consisting of five systems has three systems that contain interactions of the degree *Enrichment* for the interaction class *Annotations*, one system that contains interactions of the degree *Collaboration* and one that did not offer any interactions within this class. Therefore, the central tendency for this interaction class would be the median of the numbers 3, 3, 3, 5. This equates to a degree of 3 (Enrichment) for 80% of the systems (as one has no interactions in this class).

To match cultural heritage information systems to the framework, a codebook (see appendix D) was developed listing interactions and their corresponding interaction class and interaction degree. It is coherent with the interaction matrix shown in chapter 5 in the tables 5.7, 5.8 and 5.9. This codebook guides the code form (appendix E). Here, scenarios or questions were derived that were used to assess each of the systems in the extended sample. For each interaction class, a list of user interactions was compiled. Each implementation of these interactions was indicated with a tick box in the code form (figure E.1). Each ticked interaction translated to a

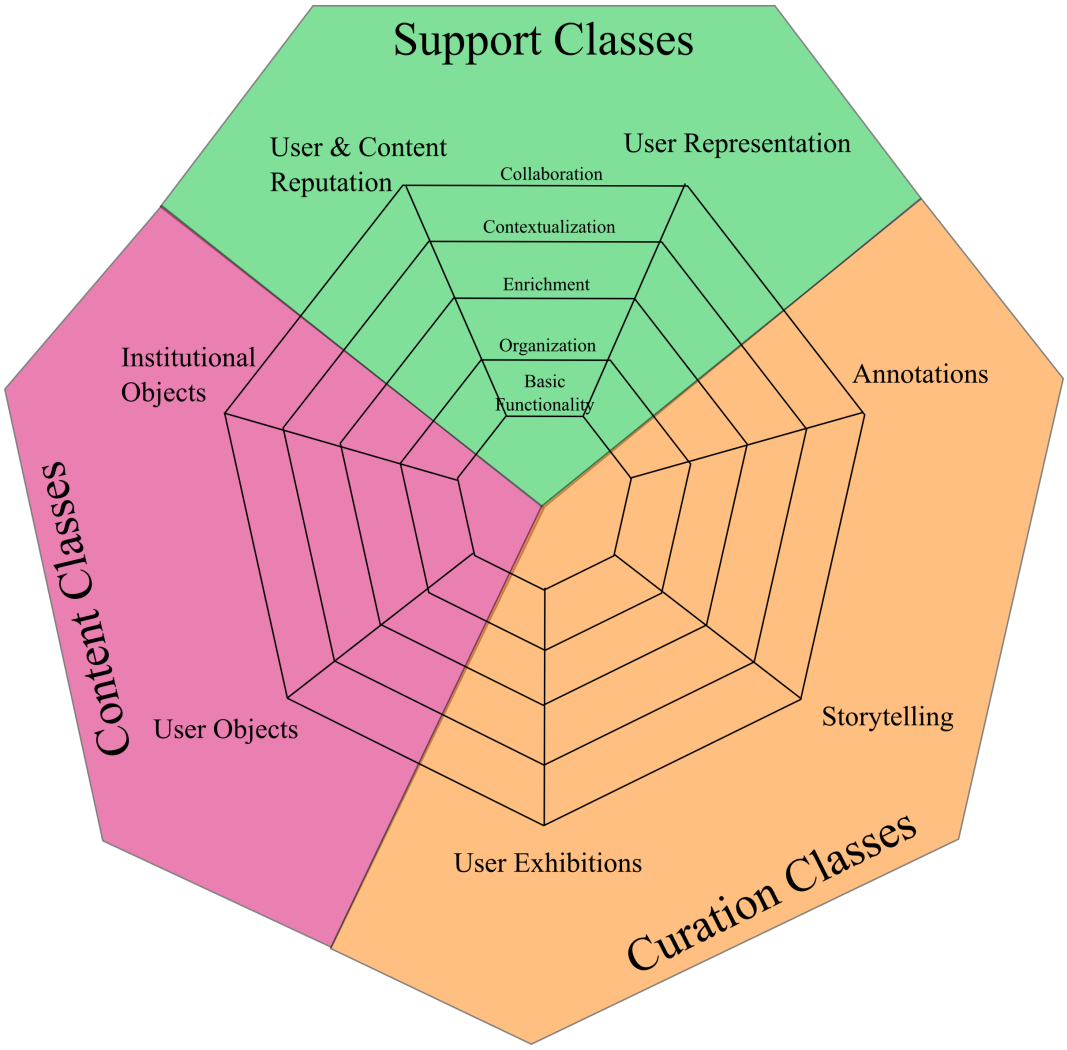

Figure 6.1.: Radar model of the interaction framework for analyzing interactions.

Table 6.1.: Interaction degrees on an ordinal scale.

Degree of interaction	Ordinal scale
Basic Functionality	1
Organization	2
Enrichment	3
Contextualization	4
Collaboration	5

certain interaction degree based on the codebook (see appendix D).

Each of the 72 cultural heritage information systems of the extended sample was analyzed and its position in the framework determined. To compare systems with similar characteristics, the analysis was conducted in groups that clustered information systems of the same type. Consequently, it is possible to make assumptions about the characteristics of the interactions in each group resulting in an in-depth analysis.

6.2. Analysis of Interactions in Cultural Heritage Information Systems

The extended sample consists of 72 information systems clustered into one or more of the following six groups: *Museums, Libraries, Archives, Communities, Aggregators* or *Collections* (a full list of the systems can be found in appendix C). These groups are not mutually exclusive, i.e. one system can belong to several groups given that they fulfill the characteristics provided in table 4.1. Table 4.3 shows the groups and the number of observations per group in the extended sample. In the following, each group is analyzed, succeeded by a comparison of all groups.

6.2.1. Museums

In the *Museums* group, 34 information systems were studied. Table 6.2 shows the number of systems that implemented a given interaction class with the respective median degree of interaction. It shows that the *Museums* group is striving to implement *Curation* interactions like *User Exhibitions*. In more than half of the cases, users can create customized exhibitions. The other *Curation* interaction classes are

not implemented that often, but if provided, they are highly developed up to the *Contextualization* level, e.g. in the *Storytelling* class.

In terms of *User Representation*, the user account is rarely used as a social tool to connect different users and their actions in the system. Nevertheless, four systems of the sample implemented *User Representation* interactions to the *Contextualization* degree. Almost none of the systems allows users to upload their own material.

Table 6.2.: Percentage of *Museum* systems implementing an interaction class with the median degree of interaction.

Interaction class	**Percentage of systems with interaction class**	**Median degree when implemented**
Institutional Objects	97%	3
User Objects	15%	3
Annotations	35%	3
User Exhibitions	53%	2
Storytelling	6%	4
User Representation	44%	1
User & Content Reputation	21%	3

Figure 6.2 illustrates the range of degrees within each interaction class for the *Museums* group. It shows a matrix of the interaction patterns prevailing in museum information systems. The color-coding represents the percentage of systems that share a certain interaction and their degree. The bluer each cell, the more systems share these interactions. For example, in the interaction class *Annotations*, 35% of the systems implemented interactions to the degree of *Basic Functionality* and 26% to the degree *Organization*, 18% implemented it to the *Enrichment* level, 6% to *Contextualization* and only 3% to *Collaboration*.

Most systems offer simple search and browsing functionalities for their material. Engagement features are implemented only in a few of the systems with *User Exhibitions* being the curational activities implemented the most. Once implemented, they reach a high interaction degree up to *Contextualization*.

	Basic Functionality	Organization	Enrichment	Contextualization	Collaboration
Institutional Objects	97%	97%	88%	11%	0
User Objects	15%	12%	9%	6%	0
Annotations	35%	26%	18%	6%	3%
User Exhibitions	53%	29%	21%	6%	3%
Storytelling	6%	6%	6%	6%	0%
User Representation	44%	15%	15%	12%	0%
User & Content Reputation	21%	15%	12%	3%	0

Figure 6.2.: Occurrences of interaction classes and their degrees in the *Museums* group.

Content Interaction Classes

As shown in figure 6.2, most systems in the *Museums* group are on the *Enrichment* level of the *Institutional Objects* class. They offer access to their digital cultural heritage artifacts and their metadata through searching and browsing. All information systems offer fielded search or some form of advanced search. Support for users in formulating queries is rare. Hardly any system offers auto-completion or query suggestion. One reason for this is that the system is often just the museum's internal collection management system augmented with a front end for web publishing. In many cases, search is limited to the fields described in the metadata and originally only designed for internal use. Overcoming these templated search schemas requires search knowledge and resources. With new museum systems being launched, one can see a trend to provide search options that are more adapted to user needs, some even going beyond the traditional text-based retrieval. For example, the Rijksmuseum offers a facet in its search that lets users retrieve items by

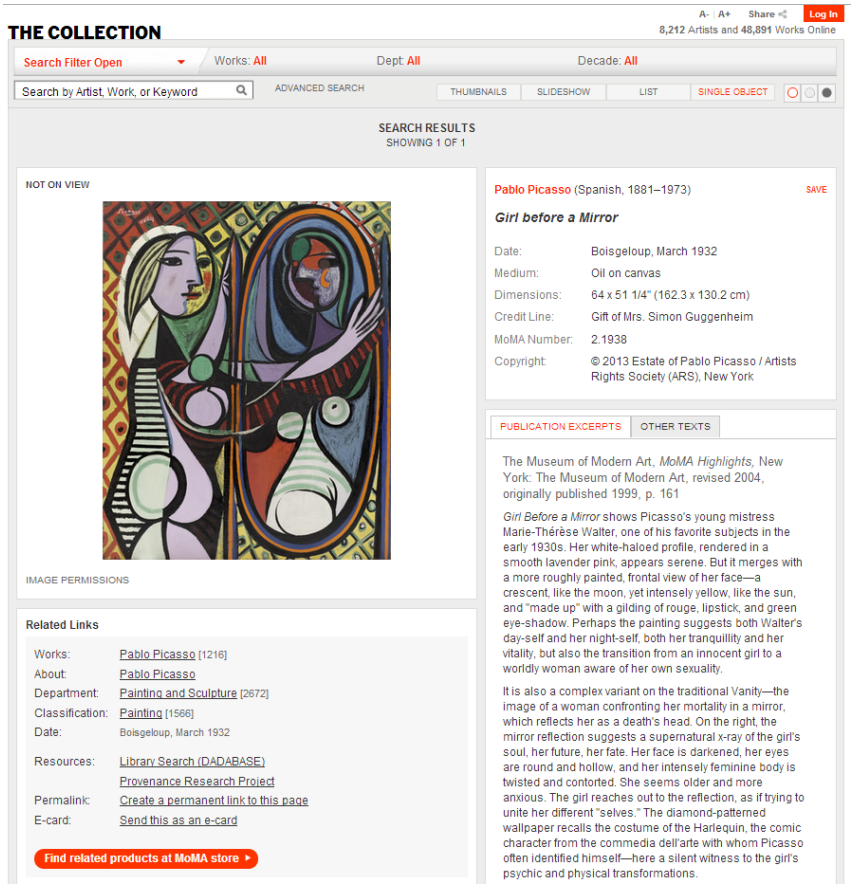

Figure 6.3.: Full view page of digital object enriched with additional information at MOMA.

their dominant color.

Museums do not only display their objects and metadata, but also offer further information that is highly curated. Figure 6.3 shows a typical full view page of an object with a thumbnail and the describing metadata of the Museum of Modern Art (MOMA). Often, this is enriched with additional information regarding the creator, related objects and publications. It helps users to learn more about a particular object and explore new content they might not have been aware of. Therefore, the MOMA reached the level *Enrichment* in the *Institutional Objects* class.

Only in rare cases, this information is contextualized with third party resources. In general, the hosting institution provides information about the objects. One reason might be the technical implications of enriching content with external sources; the other reason might be concern about linking to an external source the museum

has no control over.

With the limits in search due to expert vocabulary and the lack of resources to enrich metadata with more user-friendly descriptions, browsing is the prevailing feature for museum systems to let their users explore their material. Curated online exhibitions and collection highlights are presented to users, offering them easy access to the collection and making them curious to explore further. The goal of these curated collections is to transport a certain meaning or message or to educate the audience or sections of the public such as children. Especially larger museums offer curated content in the form of videos or interactive multimedia content. An example is the British Museum, which offers videos for children to explore different highlights of its collection. These types of educational and learning resources are important means of engagement, which still enforce the role of museums as authorities for interpreting cultural objects. In general, such educational offerings are completely separated from the collection information.

With regard to *User Objects*, only systems that also carry attributes of the *Communities* or *Collections* group support the upload of user objects - pure *Museum* systems are reluctant to offer such features. One example with interactions in the *User Objects* class is the Nationaal Historisch Museum, which offers users to upload their content. The system is not a museum in the traditional sense, but was developed to accumulate cultural material across institutions and engage users online. As it has a strong user-oriented approach with a focus on social engagement, it was classified as a *Museum* and a *Community* system at the same time. The system was originally created to connect data from different institutions with the historical information that is already online. The vision was to unify the collective knowledge and enrich it in a collaborative effort (Visser, 2010)[1]. Another four out of the currently running systems in the *Museums* sample offered users the possibility to upload their own material.

For *Museum* systems, user content could lead to many risks that would need to be reduced by ensuring property rights, supporting maintenance and preservation, and preventing abuse. To find the balance between the engagement of users and minimizing the risks that accompany user-created content, efforts in this direction are often treated as independent projects with no influence on the underlying source data. Museums still want to separate their content from content of other sources such as users.

[1] Unfortunately, since 2012 this system has not been maintained anymore due to funding cuts (Visser, 2011).

In recent years, there has been a noticeable shift in the mindset of museums towards understanding the user as an integral part of the exhibition. This *participatory design* influences the exhibition design within the institutions, and often users can interactively shape their museum experience. In information systems, however, the user is not invited to contribute material. This only happens to a limited extent and with a clear distinction from the authorized material. Often, museum systems create separated web entities for projects that might involve user engagement. Unfortunately, these projects are often not embedded into the information systems and are of a temporary nature with the content diminishing or disappearing when the project is over. There is no consistent effort to make these user contributions part of the museum collections. Many of these projects can be found in the *Collections* group. Therefore, museums usually only reach the *Enrichment* level within the *Institutional Objects* class and hardly any museum has interactions in the *User Objects* class.

Curation Interaction Classes

Social tagging as one interaction of the *Annotations* class is often implemented in *Museum* information systems, whereas other annotations such as comments or free text are usually not incorporated. Tagging can be beneficial when a community supports it and the workflows are guided. An example is the Brooklyn Museum and its sophisticated tagging implementation that reaches the interaction degree of *Collaboration*. Figure 6.4 shows a full view of a digital object with its tags attached to the right. Linking users to the tags they have created and making this link visible in the box in the lower right achieves a sense of community membership. Tags and users are clickable links that enable other users to pivot browse the collection and slice the data to reveal different perspectives. Here, the tag - user - object - relation ship is fully exploited. Additionally, the museum found a clever way to ensure a high quality of their tags. Everyone can delete and reconsider tags. These tags become part of a tagging game where users get scores for determining whether a tag is suitable for an object or not. The collaboration aspect of the tagging feature is very transparent. It allows users to work together on a common goal. The resulting data is then fed into the underlying source data, enriching it and thus making it more accessible.

In the classes of *Curation* interactions, *User Exhibitions* are the most common form of interactions, with over half of the institutions offering such a feature. Usually, this simply means that users bookmark digital objects that are then aggregated

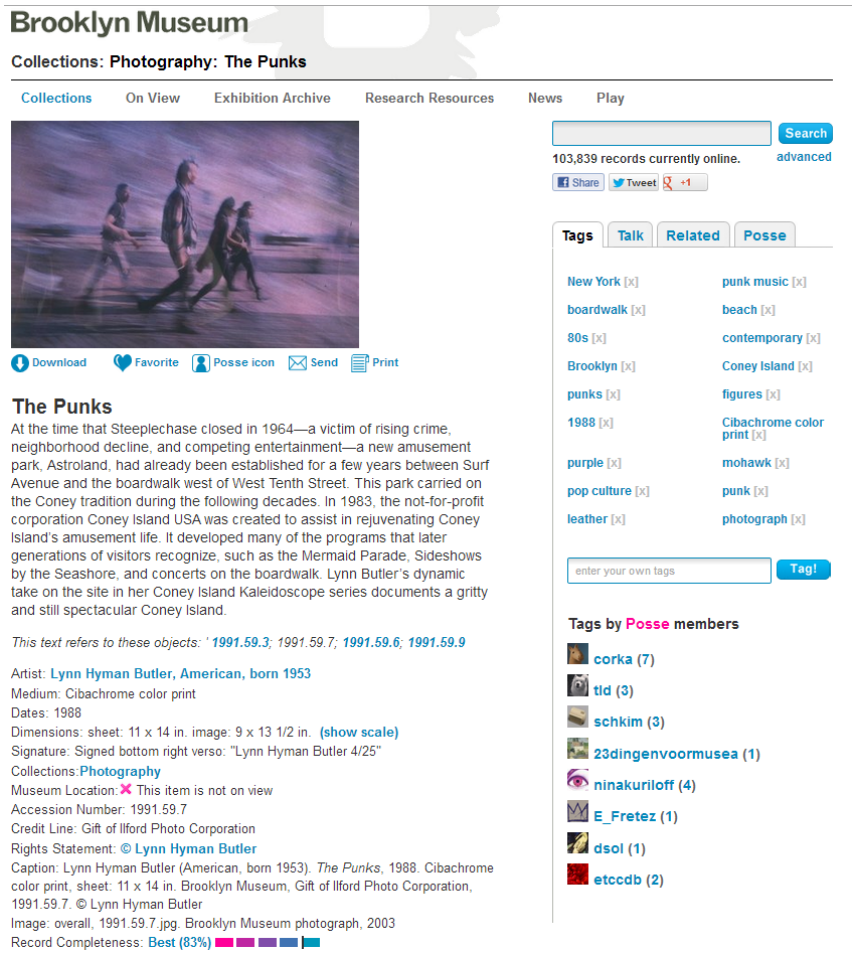

Figure 6.4.: Object full view with tags and the contributing users on the right side at Brooklyn Museum.

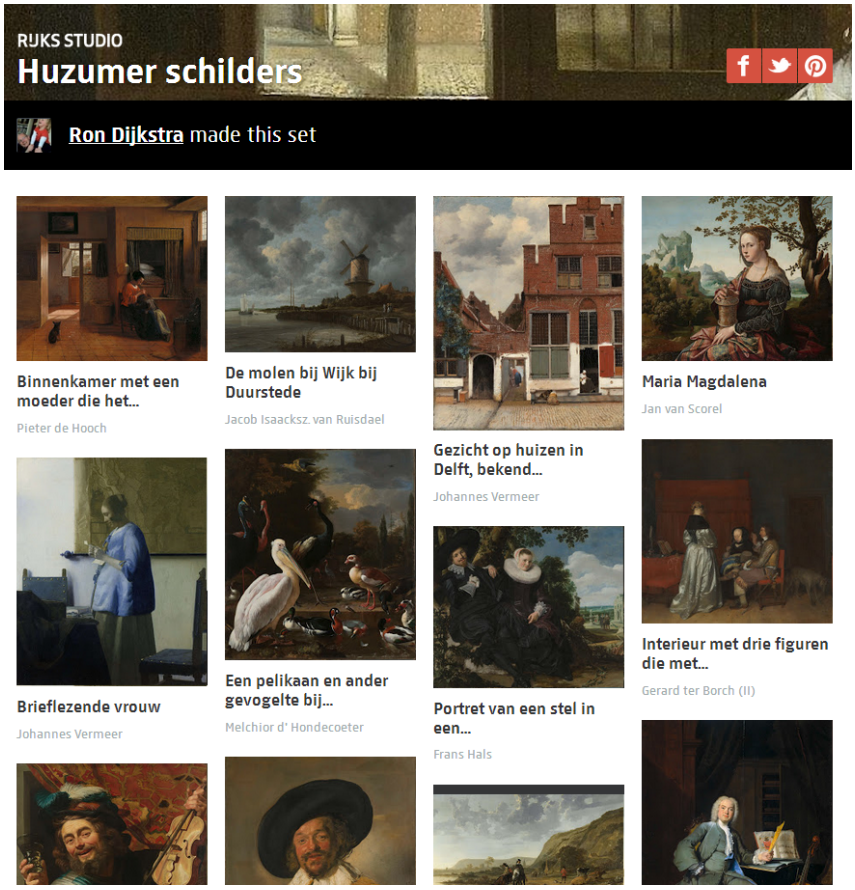

Figure 6.5.: Public user collections at the Rijksmuseum.

into sets or collections. Eight out of the 18 museums with interactions in the *User Exhibitions* class implemented a bookmarking feature that lets users save items for future visits. In some cases, the feature is accompanied by the possibility to save searches. These types of user collections are targeted towards personalizing the user experience but do not encourage sharing and participation online, which is why they reach the degree *Basic Functionality*. Others took this a bit further by integrating the user's collection into the system, thus making it part of the content offered in the system. The Rijksmuseum (figure 6.5) offers user exhibitions that are publicly available and connected to the user's profile (degree: *Enrichment*).

Research has shown that although users like the idea of creating personal collections, in reality they rarely use them (Marty, 2011). One reason for this is the lack of incentives and a convincing use case why these collections should be created and then be revisited. Half of the information systems that offer users to save a favorite

item of the collection lack a convincing purpose why the user should engage in such an activity. Saved objects can be accessed in a personal space, such as a user account, but are not accompanied by a participatory strategy. Exhibitions cannot be shared or rearranged and just function as a bookmarking list. For users, there is no additional benefit in saving an object to a list when it could also be bookmarked in their own browser saving them the trouble to log into a separate system to access it.

In the museum context, *Storytelling* is both targeted towards physical experiences in museums (e.g. Johnsson, 2006) and in digital environments (Tan & Zhong, 2009). Most of the systems analyzed have no digital storytelling feature, as it would entail complex interactions as well as multimedia functionality and moderation. One good example of storytelling is provided by the Nationaal Historisch Museum that enables users to upload their material and link it to the resources available in the system. Figure 6.6 shows a user contributed story and how it is embedded into the resources of the system. Users can specify different people and places as being part of the story; they become links interconnecting the content of the information system (class: *Storytelling*, degree: *Contextualization*).

Although storytelling is seen as an integral part of exhibition design, it seldom takes shape as an interactive tool in museum information systems. For one, the technical possibilities for this are not mature enough, and it provokes the same anxieties as other user-contributed features.

Support Interaction Classes

All interactions that infer a social experience like user accounts and user relationships are listed here. In most cases, these interaction groups are the requirements for participation and collaboration. 15 out of 34 systems offer a user space were users can customize their visit or log into a user account. The rest of the systems are of informative nature where engagement with the digital content can only happen in a limited way. Here, information flows in one direction, namely from the institution to the user imposing on them the role of consumers rather than contributors.

The systems that have implemented interactions in the *User Representation* class are doing this in a fairly limited way. Five of them offer a searchable public user profile that is associated with the action the user has performed in the system. A user profile does not only allow users to identify with the system but ensures that they leave traces in the system and, in the best case, in the digital material. This

Figure 6.6.: User story at the Nationaal Historisch Museum.

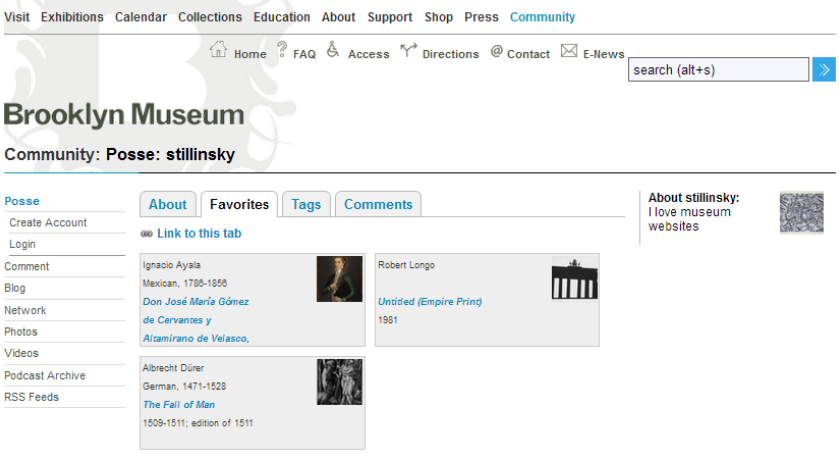

Figure 6.7.: Public user profile at the Brooklyn Museum.

enriches the experience not only for one user but also for all the other visitors. In order to identify these contributions and allow them to be evaluated by other users, a public profile is required. Figure 6.7 shows such a profile of the Brooklyn Museum. With the avatar picture on the right and the contributions the user provided to the system in the middle, this user profile displays the most relevant user characteristics corresponding to the interaction degree *Contextualization* in the class *User Representation*.

The *Support* interaction classes are highly linked to the interactions in the *Curation* classes. The higher the degree of interactions in the *Support* classes, the more purposeful the interactions in the *Curation* classes become. Ideally, a high degree of interactions in the *Support* classes is reflected in a high degree of interactions in one of the *Curation* classes. For example, the *User Representation* class of the Brooklyn Museum is established in form of a profile shown in figure 6.7 (degree: *Contextualization*). This profile makes the social tagging (class: *Annotations*) more valuable as it connects user, tags and tagged objects. The profiles make the relationship between the user, the tag and the tagged resource visible and consequently helps to create more access points. Furthermore, through profiles users can be identified in the tagging game.

Additionally, the *Support* interaction classes help to set incentives. For example, an incentive for users to create user exhibitions is often provided by the public attribution of their work when connecting profiles to the user-generated collections (class: *User Representation*, degree: *Enrichment*). This gives users a sense of responsi-

bility and acknowledgment, as they know that their collection is visible and searchable by all other users. The Rijksmuseum delivers such an incentive: it features a user's collection on the object's full view page, showing other users that the object was used in the collection created by this user. This is maximum exposure of a user's work that helps to contextualize the art object. Furthermore, each user can see other users' actions, here the created collections on a user's profile page (figure 6.5). Together, these interactions accumulate to the degree *Contextualization* in the class *User Representation* for the Rijksmuseum. Another purpose pursued by the Getty Museum allows users to map the location of their bookmarked items to the floor plan of the museum, so favorite items can be easily found during the next visit to the museum. Again, this incentive creates a customized experience, whereas other incentives are oriented to enable users' shared experiences. Both approaches have proven to be successful.

It is essential to offer user representation if user participation of any kind is desired. A successful user representation strategy ensures that user contributions are sustainable and valuable for the hosting institution.

Only a couple of systems (7) implemented a reputation strategy (class: *User & Content Reputation*), although it is desirable for allowing purposeful interactions. Users need to see their impact and get feedback on tasks and perspectives they have contributed. This interaction class is very powerful in encouraging users to participate on the one hand and creating sustainable content on the other.

In the museum participation context, participation needs to be guided and user input to be valued to set incentives to participate and produce qualitative content or contributions (Simon, 2010). The Brooklyn Museum (figure 6.8), for example, values user contributions by mentioning those users who are most active and shared the most tags (class: *User & Content Reputation*, degree: *Contextualization*).

With measuring the user reputation, the content gains valuable visibility, too. An easy way to do this is counting and displaying the times users liked a particular item. This lets users express their opinion about certain artifacts and shows the institution which items are actually preferred by the audience. The Rijksmuseum employed a "like"-feature in the form of a heart users can press on each full view item. This automatically adds the object to their collections. A number on each object page indicates how often this item was liked.

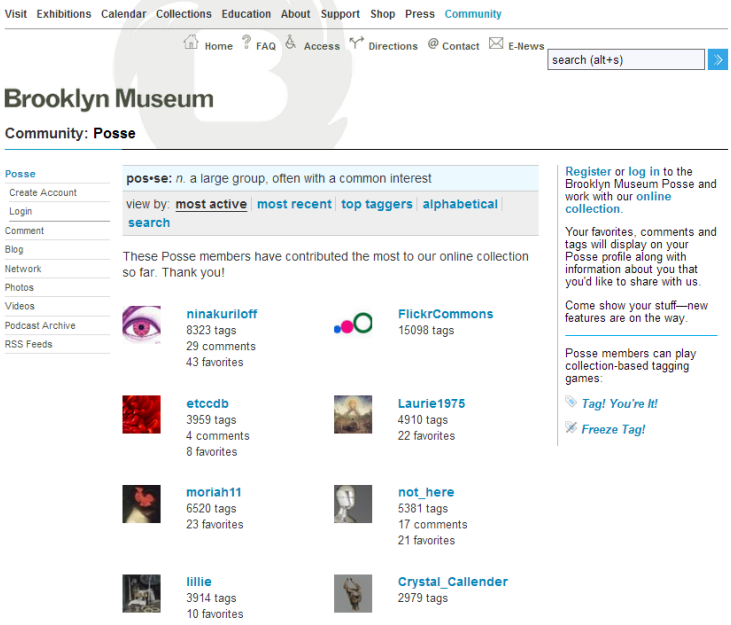

Figure 6.8.: Most active users are acknowledged at the Brooklyn Museum.

Summary

Most of the museum information systems focus their attention on representing their content and highlighting treasures of their holdings in curated exhibitions. User participation or user contribution is not the most important feature *Museum* information system strive for. One can hardly find any *Collaboration* and *Contextualization* across the interaction classes. This sort of engagement is only allowed in controlled environments where the museums are still the determinative authority with regard to interpretation. The focus of museum systems is to present their material along with the interpretation that is set for this particular content. In doing so, museum information systems are very similar in architecture, structure and services offered to the users.

6.2.2. Libraries

In the *Libraries* group, 18 information systems were analyzed. Most of the libraries are trailblazers in offering their users online access to the metadata of their holdings. They create information systems that are targeted perfectly towards the most common inquiries in libraries, the known-item search and the subject access. Their search and browse tools are well designed, based on decades of experience. Ta-

ble 6.3 highlights the interaction classes that are represented in library information systems.

Table 6.3.: Percentage of *Library* systems implementing an interaction class with the median degree of interaction.

Interaction class	**Percentage of systems with interaction class**	**Median degree when implemented**
Institutional Objects	100%	3
User Objects	17%	2
Annotations	33%	3.5
User Exhibition	67%	1.5
Storytelling	0	0
User Representation	67%	1
User & Content Reputation	28%	2

The *Library* systems in this group implemented *Institutional Objects* interactions up to the *Enrichment* level and have a strong presence of *User Exhibitions* and *User Representation* interactions (see figure 6.9). Traditionally, library patrons became members of a library to borrow books or to use other library services. In most of the cases, the membership is also reflected in the information systems. Users can access their account and manage their borrowings and the services of the hosting library. Additionally, libraries are characterized by restricted access to some of their services, which are reserved for library patrons only. The general Internet public might not be able to access all services and interact and engage with the content; this is especially true for American university libraries in the sample.

Content Interaction Classes

In general, libraries are experienced in making their content accessible online. Most of them offer access to metadata but not to the original document, although electronic materials and digitized content find their way into online library catalogues. To provide the user with the best possible search experience, libraries enrich their content with internal information. They also offer further information to contextualize their objects. The British Library, for example, provides links to further

	Basic Functionality	Organization	Enrichment	Contextualization	Collaboration
Institutional Objects	100%	100%	94%	33%	11%
User Objects	17%	11%	6%	6%	6%
Annotations	33%	28%	22%	17%	6%
User Exhibitions	67%	33%	17%	0	0
Storytelling	0	0	0	0	0
User Representation	67%	22%	22%	22%	11%
User & Content Reputation	28%	17%	11%	11%	6%

Figure 6.9.: Occurrences of interaction classes and their degrees in the *Libraries* group.

Figure 6.10.: Full view of a British Library object with external links to further information.

information at third party systems such as Amazon or the WorldCat[2] (class: *Institutional Objects*, degree: *Contextualization*, figure 6.10). In contrast to museums, library catalogs present digital objects in the form of metadata rarely augmented by thumbnails. This focus on textual representations limits the potential for creating visually compelling media shows or other forms of engagement. Traditionally, they are focusing on providing research tools for their patrons, such as private lists to save favorite items.

Some libraries provide users with recommendations based on other users' behavior. The library of Humboldt University, for example, recommends further readings based on the preferences of users who viewed the same item. More and more libraries are striving to implement such solutions to make their users' search more successful.

Libraries do not offer their users the possibility to upload their own material. This only happens in cases where the library is affiliated with an external project or is part of a third party funded project that explores new engagement options for digital library holdings online. One of these projects is Trove from Australia, a search engine for cultural heritage material that includes library holdings concerning Australia and Australians. It combines retrieval in different sources with user involvement and offers users to upload their material via Flickr[3]. This material is then aggregated and can be searched within the portal (class: *User Objects*, degree: *Organization*). The feature mentioned above is part of the strategic goal of provid-

[2]http://www.worldcat.org/ last accessed September 15, 2013.
[3]http://www.flickr.com/ last accessed September 16, 2013.

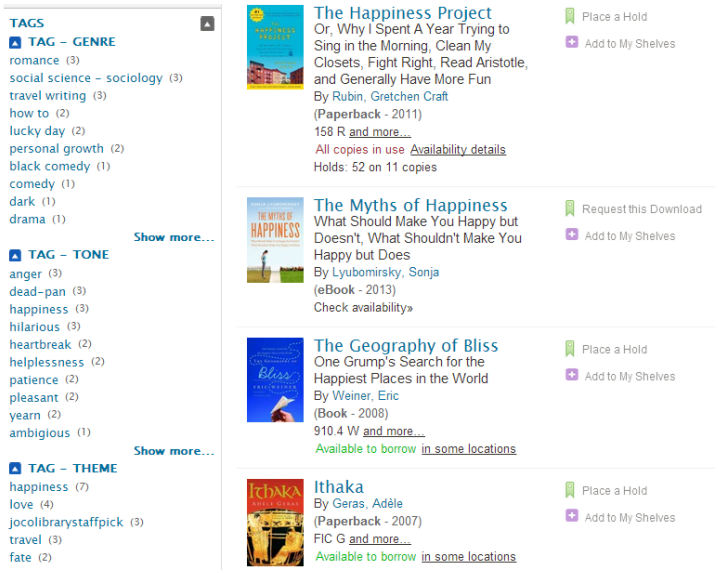

Figure 6.11.: User tags clustered in facets for refining search results at the NYPL.

ing new ways to create and share information, explicitly including user-generated knowledge (Holley, 2010b). Nevertheless, the enriched and contextualized data of Trove did not find its way back to the data providers (Smith-Yoshimura & Holley, 2012). Reasons for this might include the lack of technical solutions and limitations in the architecture of the providing institution.

Curation Interaction Classes

One third of the libraries offer features that allow users to annotate content. They are often well developed and focus on social tagging. Social tags are associated with the users who assigned them, thus increasing the access points to the material. Only two out of the systems representing library institutions allow tagging and annotations - the British Library and the New York Public Library (NYPL). Both make the tags publicly visible but do not offer a collaborative tagging system. The NYPL built a successful community around its services. Comments and the contextualization of objects with links are welcome. The library also offers tagging that serves as additional facet to refine the search results (class: *Annotations*, degree: *Contextualization*, figure 6.11).

In many cases, libraries provide a place where users can save their bookmarked items and important searches, so they can return to them later (class: *User Exhibitions*). These bookmark lists are solely for collecting items for future visits. They

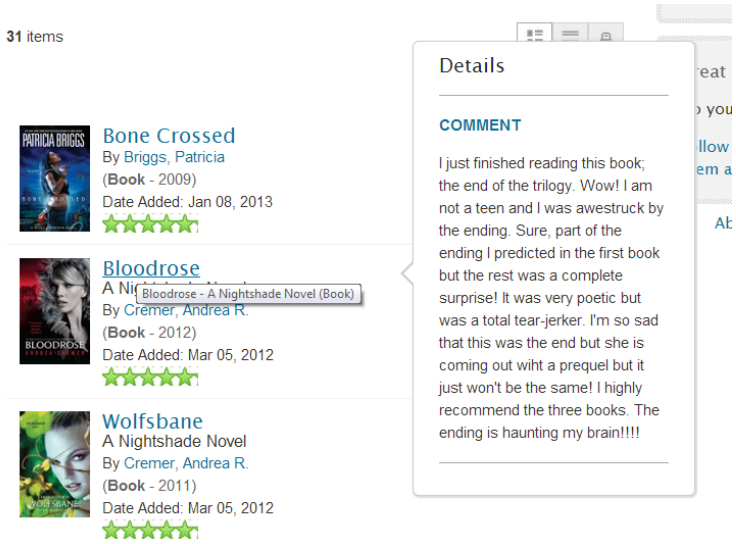

Figure 6.12.: User's virtual book shelf at the NYPL with ratings for each item and reviews attached to them.

are not public or sharable and resemble the features one can find in the *Archives* and *Aggregators* groups. Most of the bookmark lists also stay behind the registration wall for patrons and can only be used if users register with the library. This represents the *Basic Functionality* degree of interaction. Only a few of the systems implemented a guest account for saving items based on cookies for the current session.

A pioneer among the libraries in presenting users' favorite items is the NYPL. The NYPL offers user collections (so-called "shelves") that are organized by media type and show the users' items with their rating attached (figure 6.12). If users share interests with other users, they can follow each other and see which new items are put onto their "shelves". The library managed to transfer the users' bookshelves to the online world, making their personal recommendations public and providing guidance for other users. This is considered to be the *Enrichment* degree in the class *User Exhibitions*.

Libraries in the sample have no interactions in the *Storytelling* interaction class. Only two of the cultural heritage groups, namely *Museums* and *Community* systems, have implemented interactions in the *Storytelling* class. Systems in the *Aggregators*, *Libraries*, *Archives* and *Collections* group do not have storytelling features. For the first three, this is due to the fact that often only the metadata with thumbnails is pro-

vided. Building visually appealing apps is a challenge if only metadata is available.

Support Interaction Classes

User representation for social interactions is not the focus of libraries. In general, they tend to provide users with an account that allows them to manage the library services, but is not intended to function as social profile or for building a community. An exception is the NYPL, which built a community around its services. Users can review, favorite and annotate the items and have a user profile where their actions are stored. It is also possible to message other users and follow them. Nevertheless, the profile information is kept to a minimum, whereas the main focus is on the representation of the artifacts. Figure 6.12 shows the public representation of a user which comprises the bookshelves and the rating of the books in them.

Interactions in the *User & Content Reputation* class do not occur often in *Library* systems. Nonetheless, five out of 18 systems in the *Libraries* group allow users to rate the material offered. The library of Humboldt University integrated a recommender service that aggregates the users' behavior based on the collected data and recommends items. The recommendations can be evaluated (class: *User & Content Reputation*, degree: *Basic Functionality*). The most developed interactions in the *User & Content Reputation* class are again provided by the NYPL (figures 6.11 and 6.12). It offers users credits for good contributions to the OPAC. These credits act as motivators to share more high quality content and keep users participating (class: *User & Content reputation*, degree: *Collaboration*).

Summary

The *Libraries* group is not as much focused on social interaction as the *Museums* group. In comparison to the *Museums* group, more systems in the *Libraries* group offer interactions in the *User Exhibitions* class. The main reason for this is that this feature supports the research activity of the users. Interesting material retrieved by users can be saved and revisited later. In general, interactions offered by libraries are targeted towards an individual experience rather than a social one. With regard to the degree of interactions in the different classes, the *Libraries* group is somewhere between the *Museums* and *Archives* group.

6.2.3. Archives

In the *Archives* group, 15 systems are clustered from which 8 represent national archives and consequently physical entities. Table 6.4 shows the number of systems that offer a certain interaction in a given class. The figures demonstrate that archival information systems are not user-oriented and have hardly any social or collaborative character. The table reveals similarities to the *Libraries* group but with less focus on *Curation* interactions.

Table 6.4.: Percentage of *Archive* systems implementing an interaction class with the median degree of interaction.

Interaction class	**Percentage of systems with interaction class**	**Median degree when implemented**
Institutional Objects	100%	3
User Objects	20%	2
Annotations	33%	2
User Exhibitions	40%	1.5
Storytelling	0%	0
User Representation	47%	1
User & Content Reputation	0%	0

The proportion of systems that implemented *Curation* or *Support* interactions is very low compared to the other groups. Archives are shaped by the enormous effort it takes to digitize archival material, and first and foremost focus their attention on these challenges rather than user interactions. Most of the archives have not reached the point of offering access to their findings aids online, let alone the massive amount of documents they are describing. They are in a phase where they are still trying to figure out how to display their hierarchical finding aids in a user-friendly way and how to provide meaningful access to the shear amount of data they are storing. This is also reflected in the matrix in figure 6.13 showing that archives are mainly focused on the *Institutional Objects* class and hardly implement interactions beyond the *Enrichment* level.

	Basic Functionality	Organization	Enrichment	Contextualization	Collaboration
Institutional Objects	100%	100%	60%	13%	7
User Objects	20%	13%	0	0	0
Annotations	33%	27%	13%	0	0
User Exhibitions	40%	20%	7%	0	0
Storytelling	0	0	0	0	0
User Representation	47%	13%	13%	7%	7%
User & Content Reputation	0	0	0	0	0

Figure 6.13.: Occurrences of interaction classes and their degrees in the *Archives* group.

Content Interaction Classes

Archives are on the rather low end of the scale with regard to their offered interactions within the class *Institutional Objects*. For 40% of them, interactions do not go beyond a simple or advanced search of the finding aids; this represents a degree of *Organization*. They often do not have unified access to their collections and users need to search several catalogs to make sure they do not miss anything. The Nationaal Archief offers a good solution to this problem, showing all their different sources in the search results (figure 6.14).

Like the Nationaal Archief, 60% of the archives offer curated exhibitions and explorative tools for their digitized documents (class: *Institutional Objects*, degree: *Enrichment*). Innovative tools for hierarchical browsing are still missing, but good attempts are being made, for example, by the National Archives in the UK (figure 6.15). The main hierarchy shows the department (the hierarchically higher entity in the finding aid related to the government department), while the box on the right-

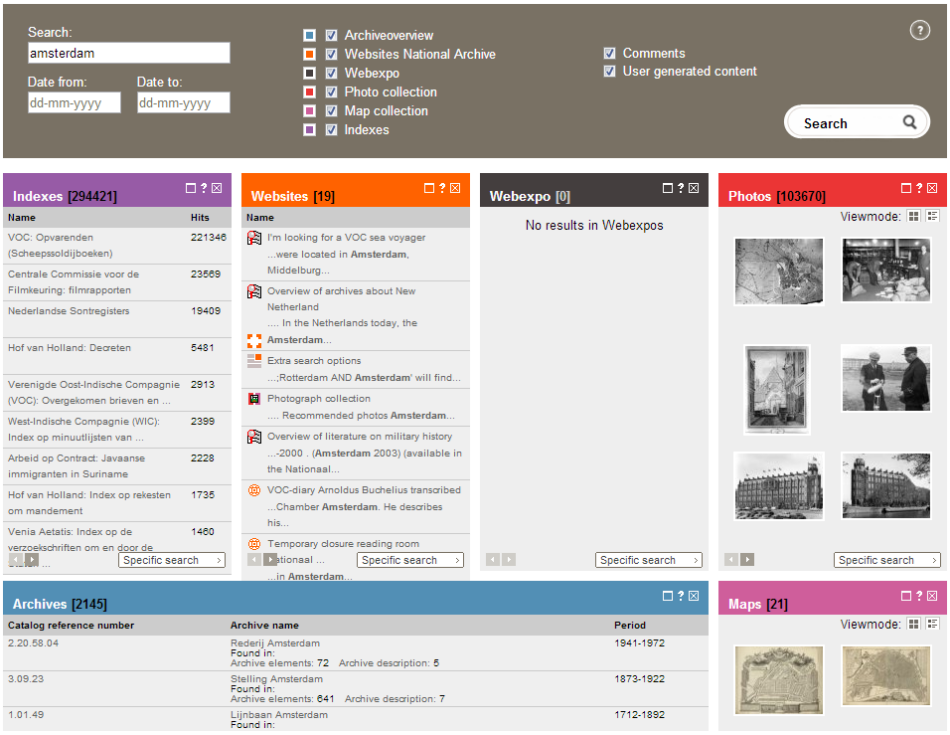

Figure 6.14.: Search results at the Nationaal Archief combining different sources and highlighting them with different colors.

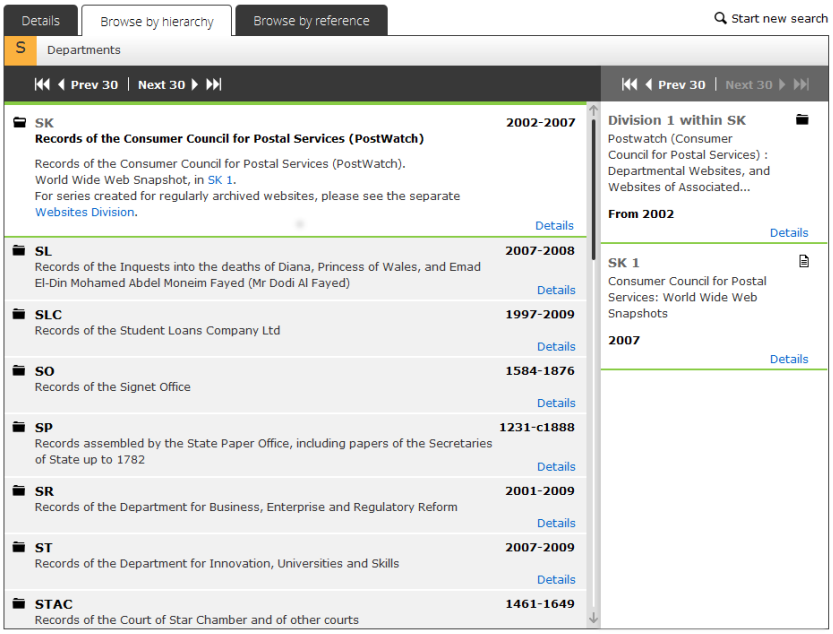

Figure 6.15.: Hierarchical browsing at National Archives (UK).

hand side lists the divisions (the hierarchically lower entity). The single records within the division can than be browsed through the bar on the right.

Similar to museums, there is generally a lack of interest and resources to provide access to user objects or allow users to upload material themselves. The only systems that offer an integration of user objects of some sort are the Nationaal Archief and Trove. The former, for example, lets users transcribe complete documents that can then be searched in full-text (figure 6.16). The Nationaal Archief has therefore reached the degree *Basic Functionality* in the *User Objects* class.

Curation Interaction Classes

Archives deal with large amounts of data and often have problems to make it accessible. The National Archives of the U.S. offers tagging for the public to support retrievability. The tags are visible next to each full view object and users are associated with them (figure 6.17). This corresponds to the *Enrichment* degree in the class *Annotations*.

Archives mainly target researchers and the researching public. As with libraries, user exhibitions usually come in the form of bookmarking items and saving them for later reference. These features are mostly for private consumption and not for

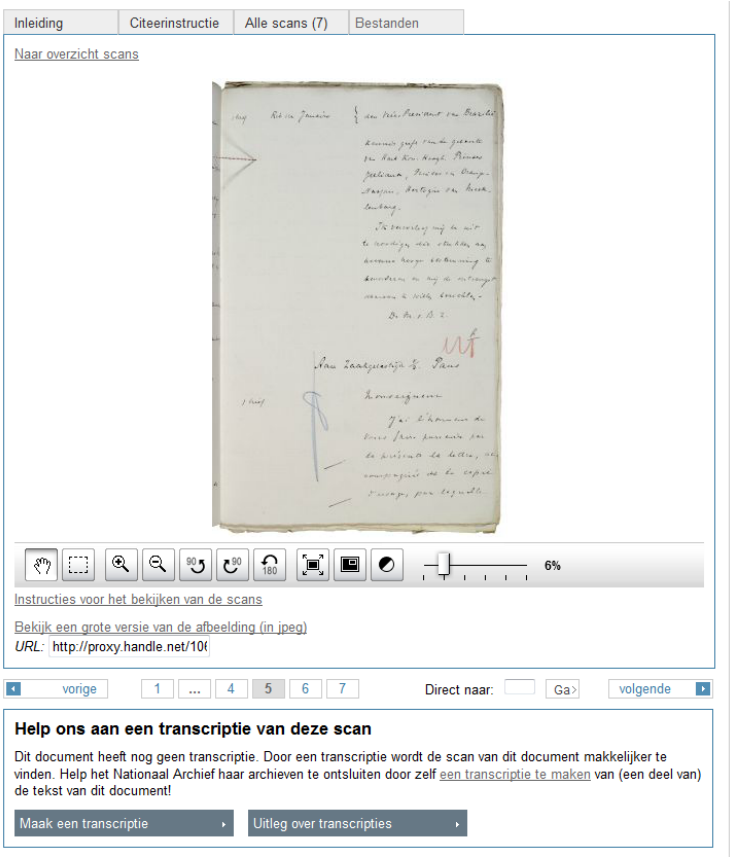

Figure 6.16.: At the Nationaal Archief, users can transcribe documents, which then can be searched in full-text.

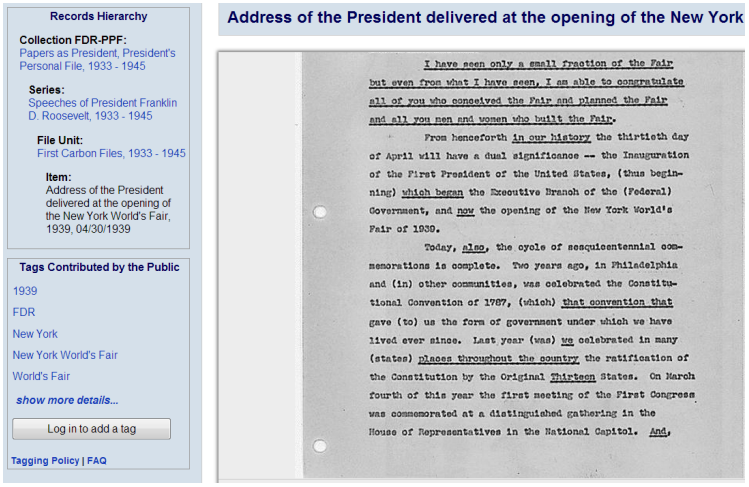

Figure 6.17.: Tagging feature at the National Archives (US).

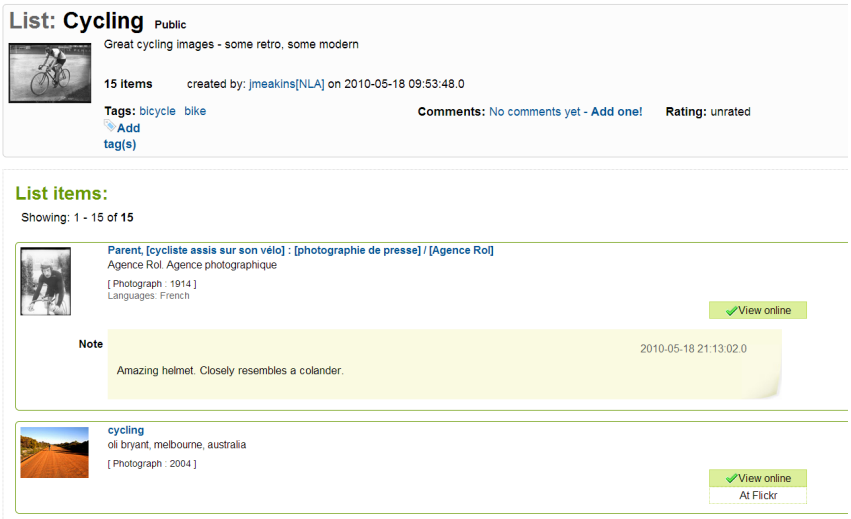

Figure 6.18.: User list with items collected around the theme "Cycling" at the Trove.

sharing objects. Most of the objects in an online archive are very specific items, interesting only to a couple of experts and not to users at large. Bookmarking lists serve the purpose to ensure that laboriously retrieved material is not lost.

Trove is the only system within the *Archives* group that allows users to publish their aggregated material in an exhibition. Items are aggregated around users' chosen themes (figure 6.18). Users can annotate the items in the exhibitions and other users can add tags to the whole collection (class: *User Exhibitions*, degree: *Enrichment*).

Interactions in the class *Storytelling* were not implemented in the *Archives* group. As mentioned before, textual representations of the content are often not suitable for building visually appealing apps.

Support Interaction Classes

For archives, the purpose of having a personalized user space does not lie in potential social aspects or customization of the experience, but in the need to process transactions and payment when users order prints or scans of the material. The user account supports the archive's business model. Seven out of the 15 archives have user accounts. Most of them are of the degree *Basic Functionality*. Similar to the systems in the *Libraries* group, user accounts are hardly developed for social engagement.

Leveraging the archival material in a profitable business model requires a cer-

Figure 6.19.: Shopping cart at the Nationaal Archief.

tain level of digital development. Only archives that have digitized objects and a mature system to discover and search these items (normally *Enrichment* level) can develop a business model to charge users for electronic or paper copies. Figure 6.19 shows the shopping cart of the Nationaal Archief, which is connected to the user account and has the characteristics of a normal web shop (class: *User Representation*, degree: *Basic Functionality*).

Open Images and Trove are the only archives that have implemented user accounts with a social experience in mind. While Open Images achieves the *Enrichment* degree, Trove reaches the degree *Collaboration*, as it lets users find groups of interest where they can discuss and share items around a specific theme.

For archives, there are no interactions in the *User & Content Reputation* class. As mentioned before, archives are not targeted towards providing a social experience. Still, archives could benefit from some form of content reputation. This would help to guide other users through the large amount of data they are handling. A "like" functionality can benefit other users in finding content they might not be aware of.

Summary

The *Archives* group is comparable to the *Libraries* group in their implementation of interactions. Both groups have no storytelling feature and a similar approach to user representation. The accounts provided to users are mainly implemented to allow users to manage the services offered by these institutions. Compared to systems in the *Museums* group, the *Archives* group shows a number of important differences. Archives are focused on providing browsing tools that enable hierarchical browsing of their difficult-to-access material. Other interactions focus on personal-

izing the user experience. Whereas museums want user exhibitions to be shared, archives focus on providing private collections and bookmarks. Both groups have the same proportion of systems offering user accounts, but archival user accounts are characterized by personalization or processing of payments rather than social aspects. This is also reflected in the *User & Content Reputation* strategy. Archives tend to have no interactions in that class, whereas museums have started to move towards the implementation of reputational features.

6.2.4. Aggregators

The *Aggregators* group includes 12 information systems. They either cover a single domain, such as libraries, museums or archives, or aggregate content across domains. Aggregators measure their success in terms of the size of their collection and often display this on their homepage. This is in contrast to *Museum*, *Archive* or *Library* systems that generally do not advertise the amount of digital objects the users can access.

Size and number of records differ considerably across the different systems. This is due to the diverse missions of the aggregators and the goals they want to achieve. The European Library, for example, joins together the collections of 48 national libraries and research libraries in Europe. Your Paintings, in contrast, is a project funded by the BBC[4] and The Public Catalogue Foundation[5] that aggregates all oil paintings in the UK and makes them accessible to the public through crowdsourcing tags describing these paintings.

As the aggregated material is often very heterogeneous, aggregators need to solve problems of metadata standardization and display before focusing on user interactions. Their unifying goal is to offer users a single access point that refers to the locations where the digital object resides. Most aggregators are not hosting the digital objects themselves but only their metadata records; digital objects stay with the provider. Aggregators redirect the traffic to content providers, making them more visible in return. They legitimate their fundings and hereby their existence through discovery tools and means that integrate heterogeneous data.

Table 6.5 shows the interaction classes prevailing in the *Aggregator* group. Many of them have implemented interactions in the *User Exhibitions* class and half of the systems allow users to add annotations. The group is characterized by interactions that mostly do not aim to engage the user, thus reaching only a slightly higher

[4]http://www.bbc.co.uk/ last accessed September 16, 2013.
[5]http://www.thepcf.org.uk/ last accessed September 16, 2013.

engagement level than the *Archive* group. Implementation of user curation occurs on a limited scale. One reason is that aggregators only have access to the metadata and do not have rich digital objects. An exception in this group is the Google Art Project that allows users to contextualize their user exhibitions and the items in them. They can afford this type of interaction as they have high-resolution images of the artworks, allowing the user to zoom in and annotate certain parts of the objects.

Table 6.5.: Percentage of *Aggregator* systems implementing an interaction class with the median degree of interaction.

Interaction class	**Percentage of systems with interaction class**	**Median degree when implemented**
Institutional Objects	100%	3
User Objects	8%	1
Annotations	50%	1
User Exhibition	58%	1
Storytelling	0	0
User Representation	50%	1
User & Content Reputation	17%	1.5

Figure 6.20 also shows the percentage of systems within the *Aggregators* group that implemented an interaction class to a certain degree. In general, it can be observed that aggregators are focused on improving and standardizing metadata by embedding additional information to it. As aggregators are not affiliated with a single physical institution but rather act as independent digital libraries, they need to offer innovative ways to discover content. This sets them apart from the online presence of other memory institutions and ensures that providers are willing to contribute content. Their main task is driven by the challenges that arise when aggregating content from different sources. Moreover, they target their services on offering customized user experiences, although the social part does not play a major role here. Their services are not yet focused on user collaboration.

	Basic Functionality	Organization	Enrichment	Contextualization	Collaboration
Institutional Objects	100%	100%	92%	17%	0
User Objects	8%	0	0	0	0
Annotations	50%	17%	8%	8%	0
User Exhibitions	58%	25%	17%	8%	0
Storytelling	0	0	0	0	0
User Representation	50%	0	0	0	0
User & Content Reputation	17%	8%	0	0	0

Figure 6.20.: Occurrences of interaction classes and their degrees in the *Aggregators* group.

Content Interaction Classes

In the *Aggregators* group, the interaction class *Institutional Objects* is shaped by their tools for content discovery and browsing (degree *Enrichment*). In most cases (8 in the sample), aggregators do not have the digital objects to offer deep-zoom functionalities or other features that would require the computational analysis of the underlying content. They focus on discovery tools that build on the metadata of the artifacts, for example leveraging fields for coverage and date. Almost all systems allow the user to discover data through geospatial or timeline browsing. Figure 6.21 shows the map browsing offered by DPLA. We see the results for a given location pinned to a map of the United States. Clicking on one of the numbers reveals the results that correspond to the location in a scrollable pop-up window (class: *Institutional Objects*, degree: *Enrichment*).

Aggregators are focused on providing a rich search experience; they need to guide users to huge amounts of data, providing them with powerful tools to re-

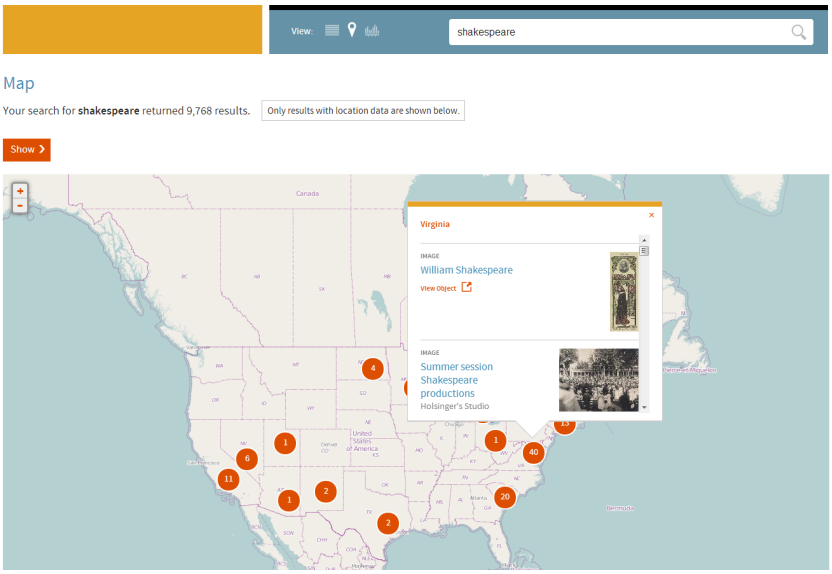

Figure 6.21.: Detail of the browsing map by DPLA.

fine search results. All of them offer advanced search and facets to refine the search results. Here, they are not as innovative as museums and mostly rely on the information in the metadata to construct the facets.

A semantically enriched version showing information on a map is offered by the Google Art Project. Locations of a digital object are shown on a map which includes the birthplace of the creators and where they died. Additionally, the object page is sometimes contextualized with external videos of the content provider (figure 6.22). Based on this, the Google Art Project reaches the *Contextualization* degree of interaction in the *Institutional Objects* class.

Aggregators are by definition occupied with the collection of heterogeneous material; often this does not include user material. Only one aggregator, Europeana, entered the uncharted territory of user objects. No other aggregator invites users to upload their material or search for material generated by other users. Europeana is embedded into research projects that strive to find innovative ways to engage the public with cultural heritage. One of these projects is Europeana 1914-1918[6], that allows users to submit their tangible and intangible memories about this period of time. After the review of a curator, this material is included in Europeana and can be searched. A tick box lets users decide whether or not they want to include

[6]http://www.europeana1914-1918.eu/ last accessed September 16, 2013.

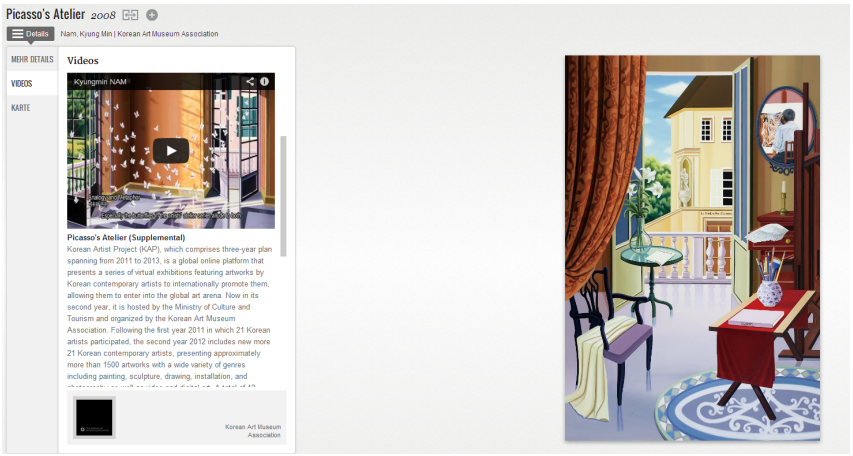

Figure 6.22.: Full view with additional information such as videos in the Google Art Project.

user-contributed data within their search results (figure 6.23). The whole uploading process of this user-contributed material is not part of Europeana but happens on an external page. Europeana only acts as an aggregator here. Nevertheless, in this role, it is pioneering and reaches the *Basic Functionality* degree in the class *User Objects*.

Curation Interaction Classes

Aggregators do not implement interactions from the *Curation* classes. They often do not have the digital objects and only host the metadata. Their efforts concentrate on making the content more retrievable with search and browsing functionalities, whereas engagement only plays a marginal role.

For some aggregators, tagging was implemented in the personal space of users, allowing them to tag saved items for later revisits (e.g. Europeana and Gallica). These annotations are not intended to be social or shared publicly, but rather have the function to organize the user's information space.

The Your Paintings project (figure 6.24) implemented more elaborated social tagging. Your Paintings provides a guided tagging workflow where users assign persons, events, concepts and locations to the paintings in separate steps. The tagging is supported with vocabulary and dictionary entries to disambiguate the tags and map them to their respective semantic meaning (class: *Annotations*, degree: *Contextualization*).

As aggregators deal with a large amount of data, they could use tagging and

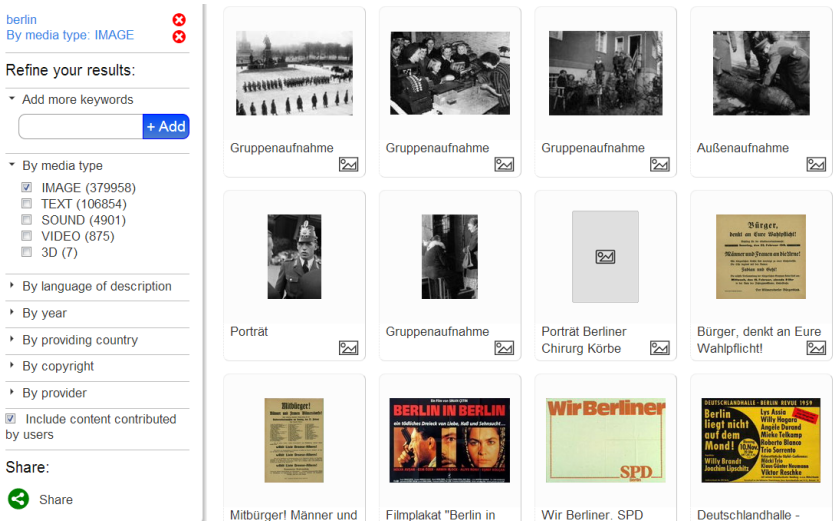

Figure 6.23.: User-generated content in Europeana can be excluded from the search results via a tick box.

annotations to enhance the retrieval of institutional objects. Only half of the aggregators take this step, which may be due to technical barriers, fear of abuse and low quality of the annotations.

Aggregators are characterized by the provision of personalized experiences with the content rather than collaborative ones. The curation of objects within the class is limited to the personal space and not for public consumption. Out of the eight systems that offered interactions in the *User Exhibitions* class, six allow users to save searches and favorite items for later revisits (degree: *Basic Functionality*). One system additionally invites the user to share these personalized lists (degree: *Organization*). In these cases, exhibitions or collections serve the research purpose of the user. Saving searches and revisiting them, as well as frequenting a list of saved items, is targeted towards users that are researching specific areas of the collection. Again, interactions in the class *Storytelling* are not implemented in any of the systems.

Two information systems stand out from the rest. The Google Art project offers public user exhibitions that can be enriched with user annotations and videos from YouTube[7], thus contextualizing the paintings with the user's points of view (class: *User Exhibitions*, degree: *Contextualization*). The BBC's Your Paintings project allows the user to aggregate and annotate favorite items and share them with others

[7]http://www.youtube.com/ last accessed September 16, 2013.

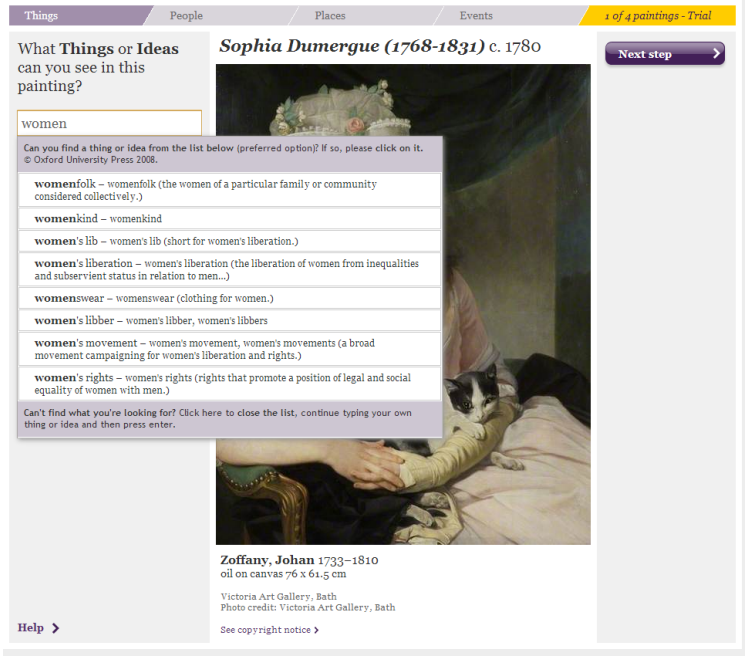

Figure 6.24.: Guided tagging work flow with autocomplete suggestions for tags at Your Paintings.

through social media channels (degree: *Enrichment*) (figure 6.25).

Support Interaction Classes

Half of the aggregators offer a user account where users can customize their experience and save favorite items and searches. In general, the user account is not used to add a social aspect to the user experience. None of the user accounts allow the user to have a public profile or transparently link users to activities they have taken within a given system. This might be due to the prevailing uncertainty what a successful social experience with aggregated content might look like. Figure 6.26 shows a typical user account as implemented by many aggregators. There is the possibility to save searches and items. This feature accommodates the workflow of researchers who often construct complex queries and might need to revisit them again. With regard to the end user, the purpose of such a feature needs to be challenged. For them, user accounts in aggregator systems often do not fulfill a specific purpose and are therefore rarely used.

For aggregators, *User & Content Reputation* only play a marginal role. The Smithsonian Institute is the only aggregator to offer *User & Content Reputation* for its

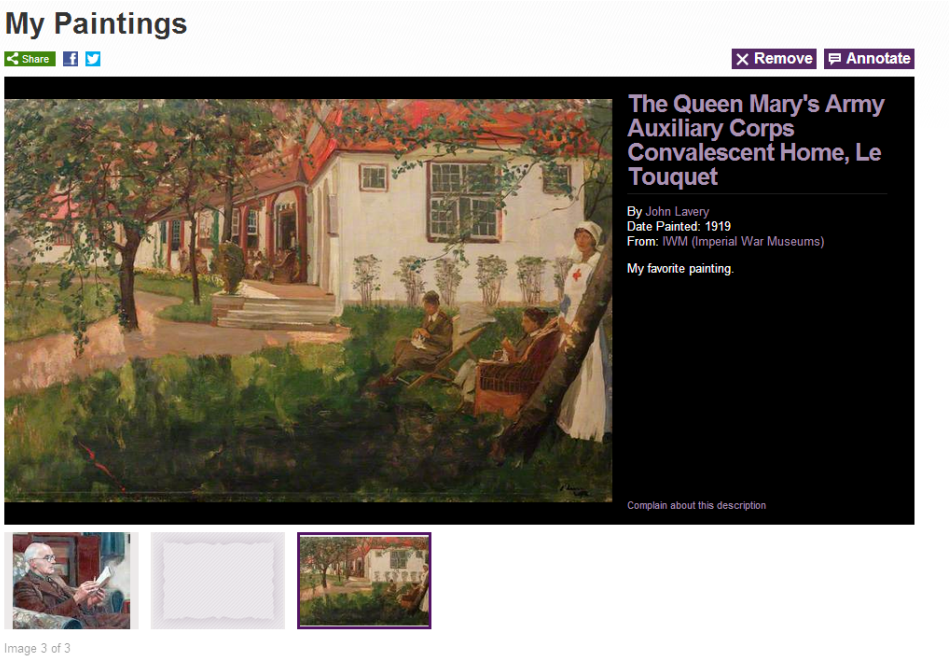

Figure 6.25.: User exhibitions with user-generated annotations in slide show mode at Your Paintings.

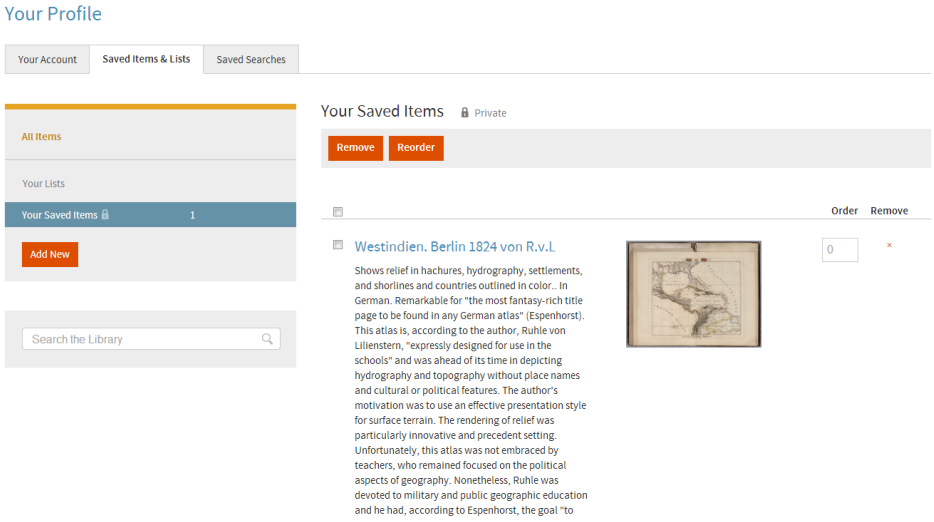

Figure 6.26.: Typical profile page of an aggregator for saving digital items and searches at the DPLA.

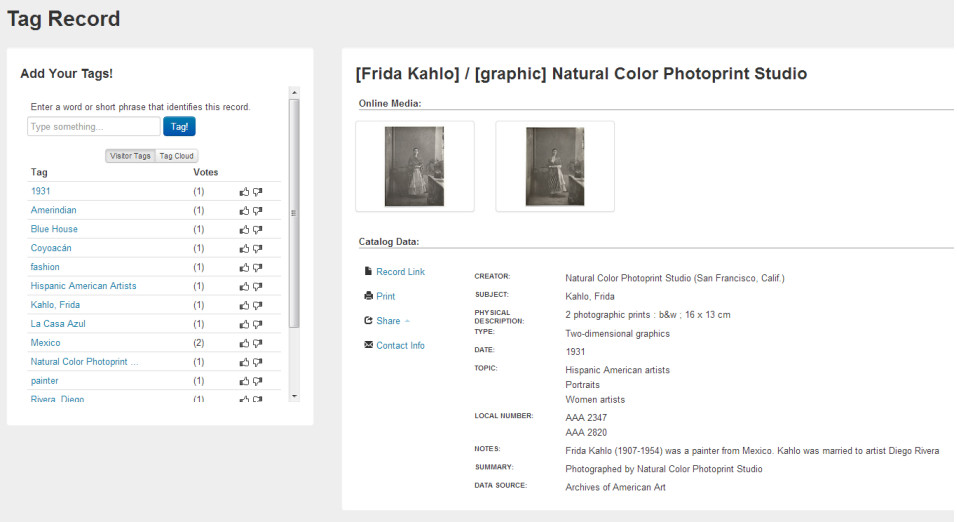

Figure 6.27.: Assigning tags and voting for existing ones at the Smithsonian Institute. The number in brackets indicates the number of votes.

user-generated tags. Every tag can be evaluated by other users with a thumbs-up or thumbs-down voting. The votes are counted and it is publicly visible to which degree a given tag is accepted for the related digital resource (figure 6.27). This is also reflected in the tag cloud that is displayed on the homepage. Nevertheless, the assigned tags and the votes are not associated with the user and not many users take advantage of the feature. The most assigned tag is "american artist", which is allocated to 23 documents. The low acceptance of the feature might be related to the lack of appreciation for the users' tags and the assigned tags not being attributed to a certain user.

Summary

Systems in the *Aggregators* group offer more interactions than the systems in the *Archives* one. The proportion of systems providing user accounts and annotations is higher than for archives, but similarly, the features are often only implemented to the degree of *Basic Functionality*. As the main goal is the provision of authority data, these institutions are reluctant to allow users to upload their own material. They have a strong focus on user exhibitions, but similarly to the *Libraries* group, they are mainly used to customize the user experience and let users save their favorite items. Social and collaborative features are underrepresented in this group.

6.2.5. Collections

The *Collections* group includes 15 systems. The material of these systems is aggregated around a certain theme. These systems can be independent of an institution, but often they are initiated as short-term projects related to an exhibition of a memory institutions. Four out of 15 information systems are created through private efforts; the remainder is affiliated with a cultural heritage institution. *Collections* systems offer interactions in all classes and there are some systems that have reached a high degree of interactions (table 6.6).

Table 6.6.: Percentage of *Collection* systems implementing an interaction class with the median degree of interaction.

Interaction class	**Percentage of systems with interaction class**	**Median degree when implemented**
Institutional Objects	100%	3
User Objects	33%	2
Annotations	40%	2.5
User Exhibitions	60%	2
Storytelling	7%	4
User Representation	40%	2
User & Content Reputation	20%	2

Systems in the *Collections* group offer the user more interactions of higher degrees than the previous four groups (figure 6.28). One reason for this is that they are targeted towards topics of smaller scope and have to unite less heterogeneous material. Often they also present a prestige project for a given institution. Resources allow offering social interactions even for a small collection. *Collection* information systems can often be considered the playground for testing new interaction features and new ways to engage the user. This is less risky than testing these features on all of the digital objects of an institution because the scope remains manageable. If these collections are not successful, they can easily be shut down.

The range of implementation of the systems is large. A couple of these systems are attributed a pioneering position when it comes to engaging interactions with digital cultural heritage. These are, for example, the ICDL and the Athenaeum. Both are very mature systems that engage users by building a community around

	Basic Functionality	Organization	Enrichment	Contextualization	Collaboration
Institutional Objects	100%	100%	73%	27%	7%
User Objects	33%	20%	13%	13%	7%
Annotations	40%	33%	20%	7%	0
User Exhibitions	60%	33%	13%	13%	7%
Storytelling	7%	7%	7%	7%	0
User Representation	40%	20%	20%	13%	0
User & Content Reputation	20%	13%	7%	7%	0

Figure 6.28.: Occurrences of interactions and their degrees in the *Collections* group.

their theme. This results in user-contributed content and better metadata, easing the access to the material for successive users.

Content Interaction Classes

Interactions in the *Institutional Objects* class in *Collection* information systems are characterized by rich browsing tools and features that let users engage with the content. All systems have implemented search and refining facets. In contrast to the other groups, *Collections* rarely offer additional exhibitions curated by experts. Normally, the composition of the systems with their cultural artifacts can be considered to be the curatorial activity. As resources are often limited to a certain topic, there is hardly any cross-linking to other resources on the system. Figure 6.29 shows a full view page with metadata attached and possibility to enlarge the picture and zoom from Maritiem Digitaal. This is the typical cultural heritage object full view on the level of *Enrichment* in this group.

Due to the specialization on a specific theme, *Collection* systems are much more

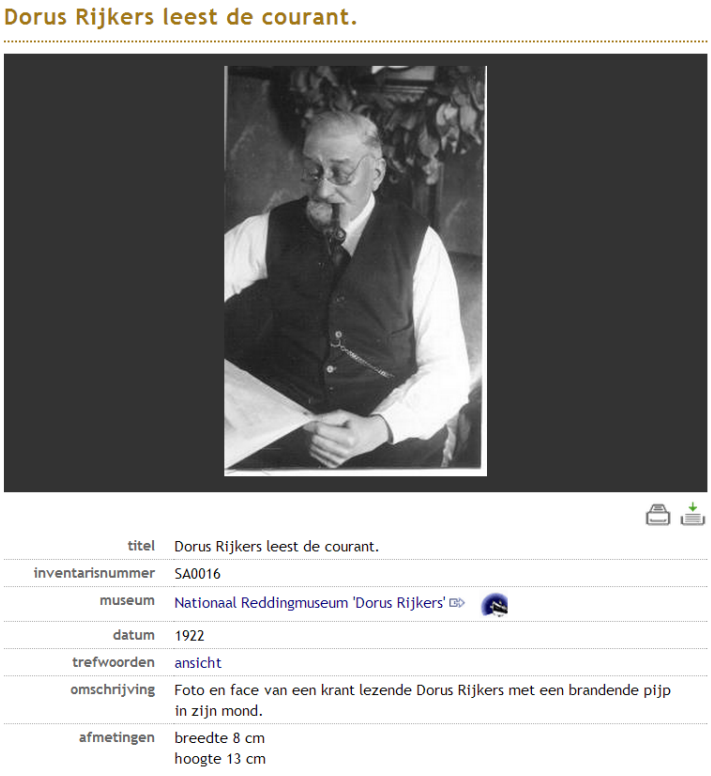

Figure 6.29.: Object full view at the Maritiem Digitaal.

Figure 6.30.: Search facets to refine results targeted towards children's books and their audience at the ICDL.

able to adapt their system to the material and users interested in this content. An excellent example for this is the ICDL. It offers facets that are targeted towards children recalling their favorite books (figure 6.30). In terms of contextualization, they also offer links for purchasing or borrowing the book in a library. Furthermore, they provide virtual exhibitions and curated activities around the books that are all linked to the full view of the object. The integration of curated content into the source data increases the access points for the material, making it easier to discover (class: *Institutional Objects*, degree: *Contextualization*).

In the *Collections* group, 33% of the information systems offer users to upload their objects. At Maritiem Digitaal and ICDL, users can upload objects within the comments about institutional objects and as part of the reviews children are writing. These user contributions are searchable, but they differ from the other content in the system. The user objects are add-ons and are not incorporated into the corpus of the institutional objects (class: *User Objects*, degree: *Basic Functionality*).

On the other side, there are systems that handle the user-contributed objects in a similar way as the institutional objects. They do not distinguish between objects coming from users or institutions. Figure 6.31 shows the Athenaeum, a system collecting art, where users contribute most of the content. Other users can add additional information to the objects and they can rate and discuss them. For this integration of user-generated content and the possibility to control and improve quality through community effort, this system reached the degree of *Collaboration* for the interaction class *User Objects*.

Figure 6.31.: Full view of an object at The Athenaeum with rate/tag/share tab and discussion forum.

Curation Interaction Classes

40% of the information systems in the *Collections* group offer annotations. In the majority of cases, tagging is implemented, which is well developed in this group. The Steve Tagger project, for example, sets out to analyze the usefulness of tags added to art (e.g. Trant, 2006, 2009). Figure 6.32 shows the feature that allows users to determine the language of the tag they are assigning. Users assigning tags in several languages can improve multilingual access to the tagged object. Often these tags are translations of each other, but they also differ due to cultural bias (Eleta & Golbeck, 2012). Features like this are rather unique in the domain but they show that there is a trend to leverage user tags for improving metadata and making it more accessible across languages.

Some information systems allow users to comment on individual digital objects. This is easy to implement if a social plug-in for commenting is provided. Artbabble, for example, lets users comment with the comment plug-in of Facebook[8]. These features support the engagement of users, but they are not practical to enrich a system's content with user-generated data.

Another form of annotation is the user review that is implemented by systems presenting books. The ICDL invites its users to write reviews about the books (class: *Annotations*, degree: *Contextualization*) and contextualize them with their own paintings (class: *User Objects*, degree: *Basic Functionality*, figure: 6.33).

[8]http://www.facebook.com/ last accessed November 14, 2013.

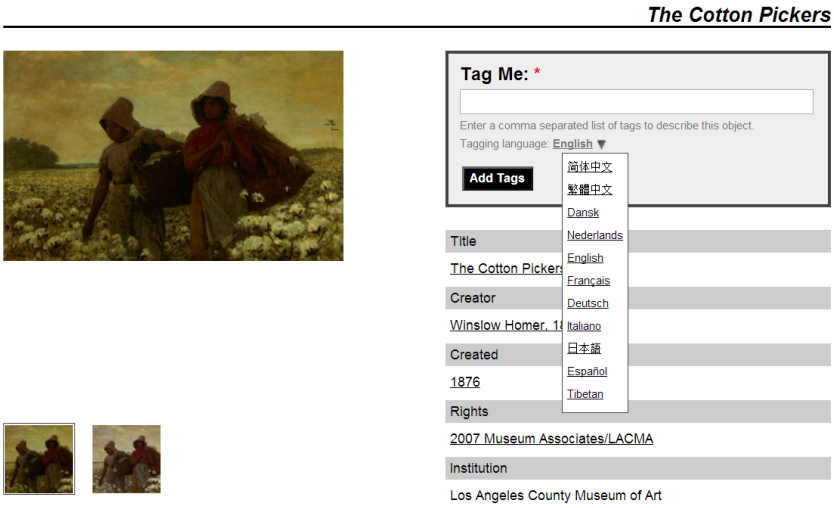

Figure 6.32.: Tagging interface at the Steve Tagger project where users can indicate the language of the tag they assign.

Figure 6.33.: User review at the ICDL with user painting contextualizing the source object.

Figure 6.34.: User exhibitions with tools to support presentations at Rumsey Map Collection.

User exhibitions are implemented in *Collections* systems in more than half of the cases. In these information systems, the interaction is complex but they are well designed. For example, in the case of the Steve Tagger project, the degree of the interaction has reached the *Collaboration* level. Users who have assembled items in a set can mark these items to be public and let them edit by other users. Unfortunately, the system is rather weak in the *User Representation* class, which might be one of the reasons why the exhibition feature is not often used. The incentive to collaborate with others on user exhibitions is not very high if there is no gain in reputation or the time invested into a project does not seem to be valued. A better solution was found by the David Rumsey Map collection. Although they do not let users collaborate on a set of favorite maps, they manage to set incentives to create online exhibitions (class: *User Exhibitions*, degree: *Contextualization*). They enriched their service with tools that are considered useful by researchers and map experts. Users can export media groups to Microsoft PowerPoint[9] and enhance the collection with pictures from Flickr. The tools are targeted towards supporting presentations of these maps at conferences or other expert events (figure 6.34).

Support Interaction Classes

40% of the *Collections* information systems offer a customized space for the user. Some of the information systems design this user experience with a focus on engaging users with the content and inviting them to have a social experience. The ICDL makes a great effort to offer children a holistic experience around their favorite books. Figure 6.35 shows a child's profile at the digital library listing all the book reviews of this particular user (class: *User Representation*, degree: *Contextual-*

[9] http://office.microsoft.com/powerpoint/ last accessed Oct 7, 2013.

Figure 6.35.: User profile at the ICDL with all the reviews the user has provided.

ization).

Another good example is the Athenaeum. Here, the user's actions are intertwined with the objects presented in the system. As many of the objects are provided by users, an incentive for users to do so is crucial to ensure that the collection develops and the quality of the data improves. Each user profile offers statistics about the user's activities in the system, making sure that these activities comply with the community standard.

By contrast, *User & Content Reputation* is not often implemented in the *Collections* group (20%). This leads to a lack of incentives for engaging with institutional objects. Only three systems offer interactions in this class. In the manner of online bookshops, the ICDL allows their users to evaluate the books and write reviews for them. The star rating given by the users serves as facet to refine the search results according to the average stars a book has gathered. Additionally, children can enrich their reviews with pictures they painted themselves. A questionnaire guides them through the review. Figure 6.33 shows the review of a user at the ICDL with a personal picture attached. It is obvious that this type of representation values the contribution of users, motivating them to provide more content or reviews. This is expressed in the *User & Content Reputation* class with the degree of *Contextualization*.

Summary
The implementation of interactions in the *Collections* group ranks between those of the groups *Museums* and *Community*. One reason for this is that *Collections* are often created out of a museum context when realizing innovative projects, with a small part of the collection themed around particular topics. These systems are usually innovative and experiment with new ways of engaging the user, often to a much higher degree than the museums providing the material. This is reflected in a higher number of systems offering interactions in the classes *User Exhibitions* and *Annotations* than for the *Museums* group.

6.2.6. Communities

The *Communities* group accommodates ten information systems that are all characterized by their ambition to provide collaborative activities around a cultural heritage theme. The interaction among users is the driving force of these systems. Institutions can provide digital cultural heritage objects, but often it is user-generated material that is the core of these systems. Table 6.7 shows the distribution of interactions across the group and the median interaction degree to which the classes were implemented.

Community information systems are striving for collaboration and want to offer their users meaningful activities that entertain and produce qualitative content simultaneously. In many cases, these systems are self-sustainable. The community makes sure that contributions reach a qualitative threshold without needing much guidance. These systems hand a lot of responsibility to the user. Generally, they do not originate from memory institutions but are hosted by other non-profit organizations or private parties. The amount of freedom that systems in the *Communities* group offer their users might spook traditional institutions. Nevertheless, these systems can serve as an example how an integration of cultural responsibility with a community of non-experts might work out.
The *Communities* group is the most mature when it comes to the implementation of interactions that support incentives for users to participate and collaborate in shaping cultural heritage. This is also visible in the matrix (figure 6.36) that shows well-developed interaction classes for this group.

Table 6.7.: Percentage of *Community* systems implementing an interaction class with the median degree of interaction.

Interaction class	**Percentage of systems with interaction class**	**Median degree when implemented**
Institutional Objects	100%	3.5
User Objects	80%	3.5
Annotations	90%	3
User Exhibitions	90%	3
Storytelling	30%	4
User Representation	100%	4
User & Content Reputation	80%	2.5

Content Interaction Classes

Systems in the *Communities* group are normally based on users contributing their content. 80% of the systems offer users to upload their own material. The only two systems not inviting user contributions are the NYPL and the Brooklyn Museum, both of which represent traditional memory institutions extending their services by building a community around their artifacts.

Interactions in the *User Objects* class are very well developed in some of the systems, which invite the community to enrich and contextualize existing and user-contributed content. For example, Historypin's service builds solely around user content. User can upload their historic pictures and embed them into the resources of the system, which was equated to the class *User Objects* with the degree *Enrichment*. Other users can comment or use these pictures as a basis for their own exhibitions (class: *User Exhibitions*, degree: *Contextualization*).

Saatchi Online brings together artists and collectors, providing a platform for the former to represent their art and for the latter to retrieve art that they might want to buy. Here, the artists create the authority for the digital objects they upload. Other people can comment on artworks, which corresponds to the degree *Enrichment* for the class *Annotations*. Additionally, users can favorite artworks, equating to the degree *Basic Functionality* of the class *User & Content Reputation*.

In general, *Community* systems strive for engagement. They depend on a strong community to ensure quality standards and develop the existing content to make

	Basic Functionality	Organization	Enrichment	Contextualization	Collaboration
Institutional Objects	100%	100%	100%	50%	30%
User Objects	80%	80%	60%	40%	20%
Annotations	90%	90%	60%	30%	20%
User Exhibitions	90%	80%	60%	10%	0
Storytelling	30%	30%	30%	30%	0
User Representation	100%	90%	90%	80%	20%
User & Content Reputation	80%	60%	40%	20%	10%

Figure 6.36.: Occurrences of interaction classes and their degrees in the *Communities* group.

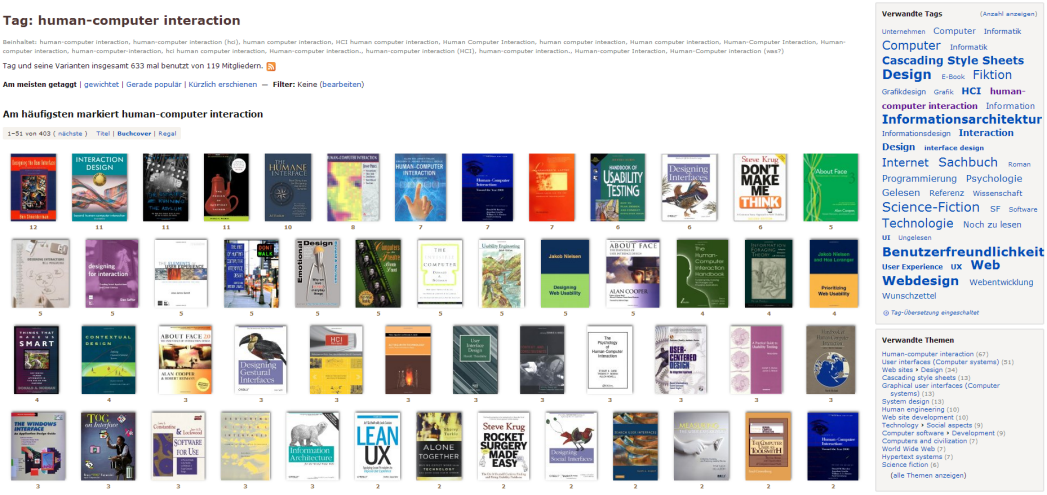

Figure 6.37.: Tag discussion page with preferred terms and similar tags at LibraryThing.

it more accessible. In all the communities, an authority is not as present as in the other groups. *Community* systems are more focused on collecting all viewpoints on a given topic. Any user engagement with a particular item increases its visibility even if the contribution might be controversial. A strong community can decrease the impact of abuse and doubtful facts. Memory institutions can learn from this handling of user content, but it requires handing some of the content responsibility to the crowd.

Curation Interaction Classes

90% of the *Community* systems offer annotations, while the degree to which these annotations are implemented ranges from pure commenting features (Historypin has the degree *Organization* for the class *Annotations*) to sophisticated social tagging (LibraryThing has the degree *Collaboration* for the same class). For a *Community* system, it is essential to let users discuss the objects of interest. In the best case, these discussions or annotations lead to higher quality content that improves accessibility. LibraryThing allows users to collaboratively decide preferred terms for tags and lets them group less common tags under the chosen term (figure 6.37). This is a good example of complete community control over quality of the content, which relates to the degree *Collaboration* in the class *Annotations*.

For *Community* systems, interactions in the class *User Exhibitions* play a crucial part in inviting users to express their views on parts of the material and reorganize

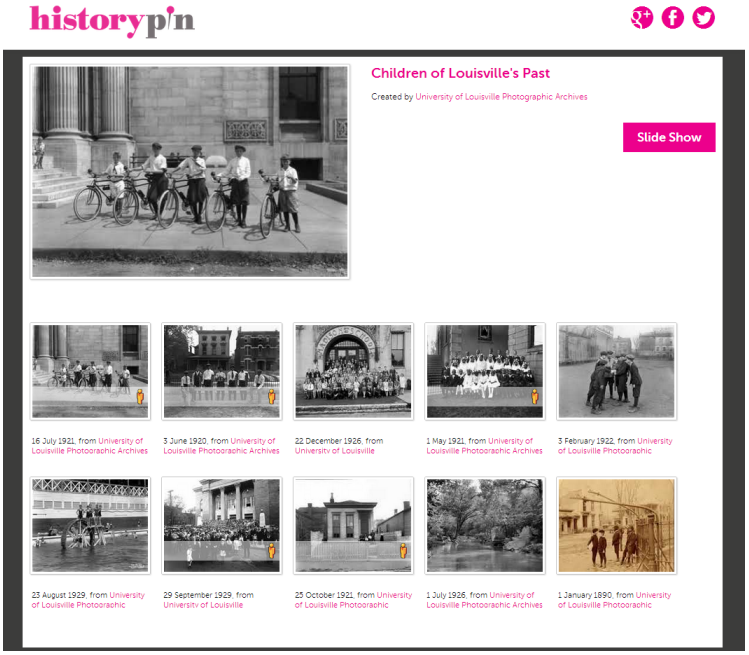

Figure 6.38.: User collection at Historypin that can be displayed in slideshow.

it to form new relations. Nine out of ten community systems offer *User Exhibitions*. The big majority of them is public, and users can add their own description to the exhibitions or the items in it. This group offers some well-designed features that, paired with a strong community, allow for rich user interactions and contextualization of the underlying content. Historypin has many user exhibitions that can be displayed in a slideshow, and single objects in it can be annotated. Together this results in the degree *Contextualization* in the class *User Exhibitions* (figure 6.38).

Storytelling is implemented in three out of ten systems in the *Communities* group. These systems have managed to provide a storytelling feature, which allows interactions with the degree of *Contextualization*. Historypin lets users create tours that guide other users through a story in chronological order. Each step in the tour can be annotated and enriched with audiovisual material (figure 6.39). In general, interactions in the *Storytelling* class are difficult to realize requiring a narrative that can become live online.

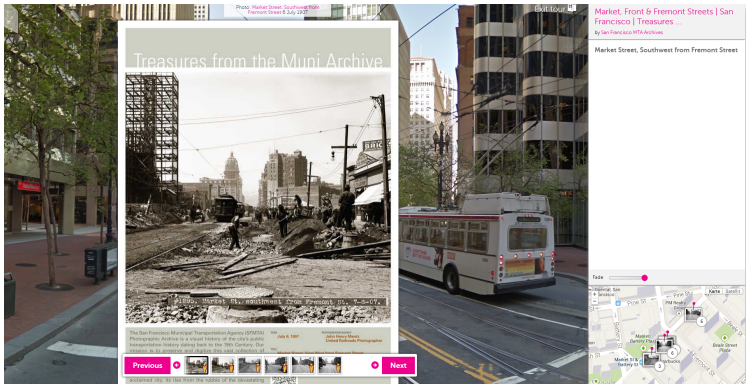

Figure 6.39.: Part of a story at Historypin with Google Maps integration and a storyline at the bottom.

Support Interaction Classes

All *Communities* group systems offer interactions in the class *User Representation*. This is obvious, as a community needs to identify its members in a way so that they can interact with each other. The profiles are targeted towards the goals the system wants to fulfill. Saatchi Online, for example, aims at bringing together artists offering their art and collectors buying it. The user profile displays the art in a prominent manner but also leaves room for presenting the artist (figure 6.40). Furthermore, on this platform, people can become friends, create collections and contact each other, all of which relates to the degree *Contextualization* in the class *User Representation*.

The group *Community* is also very strong in the *User & Content Reputation* class. 80% of the systems implemented interactions, here. users can vote on artifacts or evaluate the contribution of other users. Often static tis about the usage of particular items or collections are aggregated and displayed leading to a boost of popular content.

Summary

The *Communities* group is the one with the most interactions implemented to a high degree. The focus on user-contributed content is especially relevant. This is also the distinguishing characteristic separating the *Communities* group from all the other systems. Another unique feature of this group are the distinctive interactions in the *Support* classes. These systems focus on providing users a social experience - in contrast to other groups, which are more oriented on presenting the digital objects.

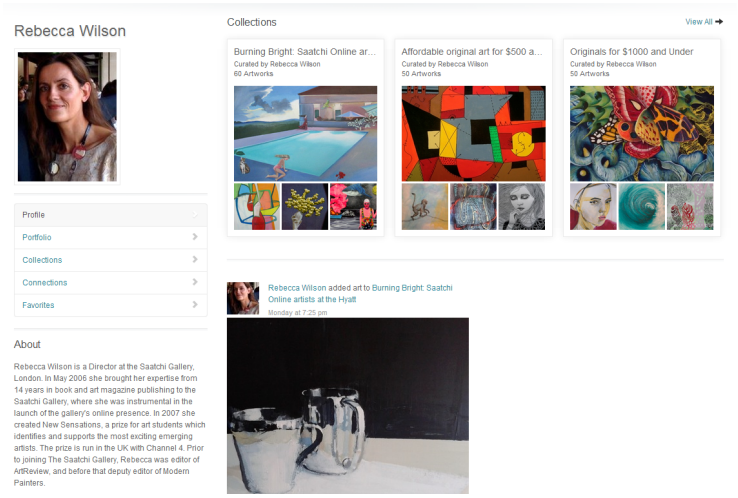

Figure 6.40.: Profile page at Saatchi Online. Users can connect with each other and send messages.

6.3. Summary

In total, 72 cultural heritage information systems have been analyzed with regard to the interactions they are offering online. Depending on their characteristics, the information systems were grouped into six non-mutually exclusive groups and were analyzed according to the framework for interactions in cultural heritage information systems. Driven by this analysis, the following conclusions can be drawn:

1. There are not enough access points beyond *Search* that support users in finding content they might not know. Most of the information systems only implemented interactions to the *Enrichment* degree, relying on *Search* and *Browse* as their modes of access.

2. Principles for participation are neglected in cultural heritage information systems and social interactions play only a marginal role.

3. If participation is implemented, then only in a separate project that has no impact on the underlying source data. The chance to enhance the digital objects leveraging participation is missed. Engagement and participation are often outsourced to different projects. Therefore, these activities rarely touch the source data and once these projects are outdated, the valuable information is not saved with the initial object.

4. Search of the digital objects and curation operate like non-connected big silos in most of the cultural heritage information systems. The curated exhibitions consist of great stories and hand-crafted information, but the digital objects that were part of these stories do not get enriched with it. The curation of objects is not sustainable as no trace of the curation is stored with the source data, and as a result, valuable information on the object's history is lost. While an online exhibition is still running, the additional information is rarely added to the collection management system. Furthermore, users searching for a particular item often do not know that it is contextualized within an online exhibition.

5. User-driven curation is generally an augmentation to the other services offered within the information system and generally does not impact the underlying cultural heritage source data. The reasons for this are missing tools for evaluating the quality of these participatory actions and fear of abusive content.

6. User-contributed objects and institutional objects are separated from each other.

7. Aggregators fulfill a special role among the cultural heritage information systems. They need to reconcile heterogeneous data from different content providers while respecting their best interest. Trying to bridge the gap between the providers' interest in gaining more traffic and the aggregators' goal to broaden the access to the material, they often decide for rich exploration tools.

The goal of the analysis was to answer the research questions of this dissertation: Do information systems from different types of cultural heritage institutions offer different interactions? If yes, what characterizes each of them? The answer to this question is: Yes, there are differences between the different cultural heritage information systems, and they are reflected in the interactions offered.

Within the group of traditional institutions, *Museum*-oriented systems are the ones that focus the most on engaging the user in innovative ways, making this a social experience that tends be collaborative. By contrast, *Library*- and *Archive*-oriented systems focus more on customizable experiences for users, implementing accounts and features that let users better utilize the services offered by the institutions. Collaboration and engagement are taking shape in *Communities* and *Collections* systems where interactions have reached a higher degree than in the

traditional systems. Figure 6.41 compares the different groups, their respective interaction classes and degrees.

Although the different information systems seem to originate from different historic backgrounds, traditionally serving users with different needs, they face the challenge that these differences are not transparent to the online user. Users generally do not care whether the digital object originated from a museum or an archive. This might explain the increasing popularity of aggregators that provide a single access point to several different and very heterogeneous collections. To offer meaningful engagement and escape the risk of becoming a search engine for cultural heritage, aggregators need to find a way to present the material, while engaging users in meaningful interactions.

In contrast to this, *Community* systems target user content and are better prepared for creating and maintaining sustainable communities. Their focus on the classes *User Representation* and *User & Content Reputation* pays off in more engaged users and a participating audience. Museums, libraries and archives should harmonize their manifold projects, which are now outsourced to *Collection* systems, and provide better ways for users to not only consume the digital material but also participate and engage with it. How this can be achieved will be further described in the next chapter where six systems from each group are analyzed. Strengths and weaknesses will be identified and highlighted, resulting into recommendations and guidelines for better system design.

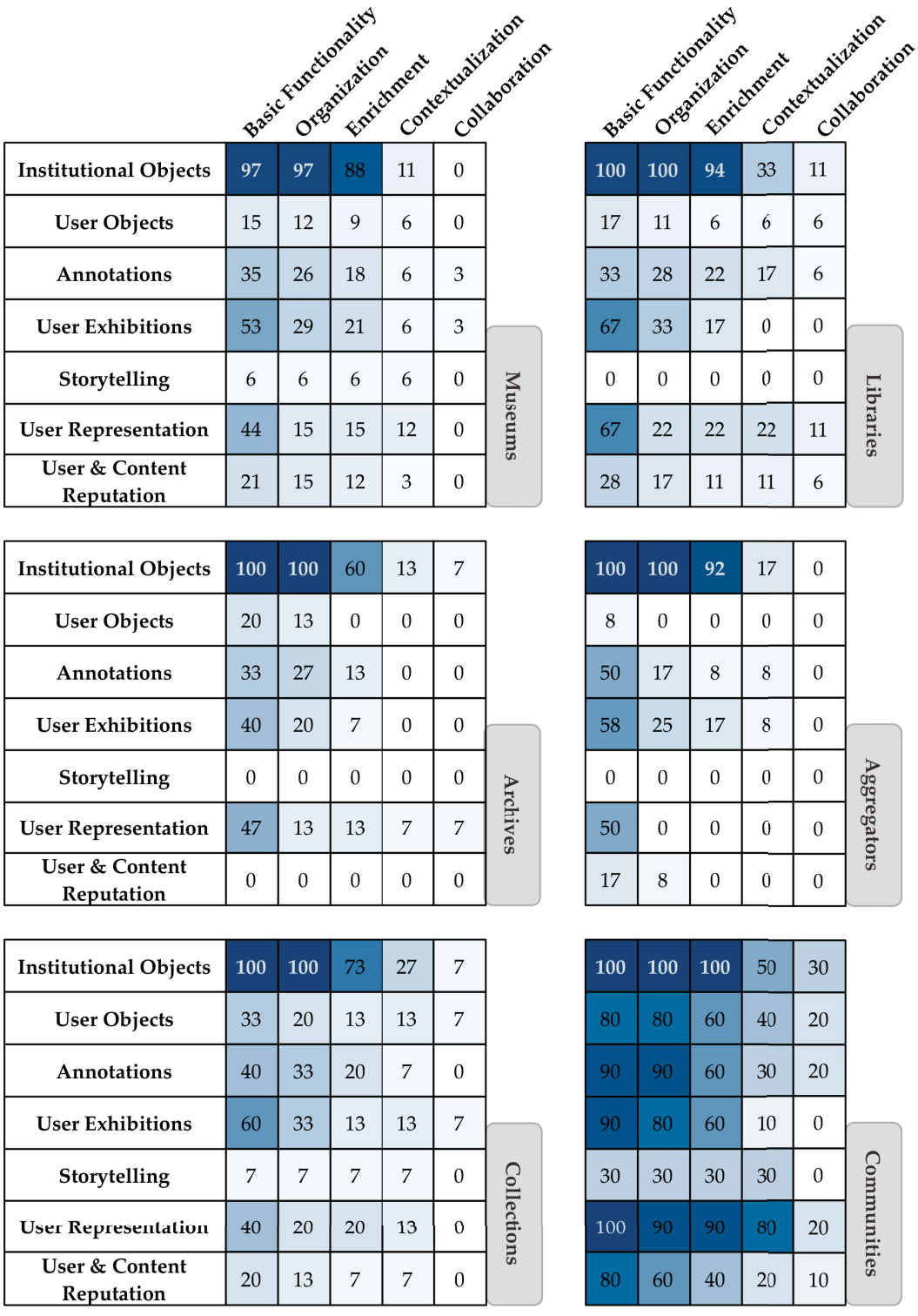

Figure 6.41.: The different groups and the interaction matrix at a glance.

CHAPTER 7

Purposeful Interactions for Cultural Heritage Information Systems

In this section, one representative of each group analyzed in chapter 6 will be evaluated in depth. The evaluation will show the system's position within the framework for interactions. The systems are visualized in radar graphs that map all interactions in a given system to the framework. They are also compared to their group, visualizing their position within the group. Here, it will become obvious which interactions classes are strongly represented in a system and which ones are overlooked. Results of the analysis will lead to recommendations for providing purposeful interactions with the goal to broaden access to the material. First, the recommendations will be given for each use case, and then they will be generalized to apply to the broad group of cultural heritage information systems.

7.1. Analytical Evaluation

In the following, six systems will be evaluated with the framework resulting in actionable recommendations. The code book (appendix D) and code form (appendix E) are used to map the interactions of each system to the framework. The interactions of each information system will be visualized with their position in the framework and each system will be evaluated in this regard. The systems are Europeana, Brooklyn Museum, British Library, Historypin, Nationaal Archief and ICDL.

The interactions of the six systems in each class are shown in comparison in figure 7.1. The graphic illustrates to which degree interactions were implemented in

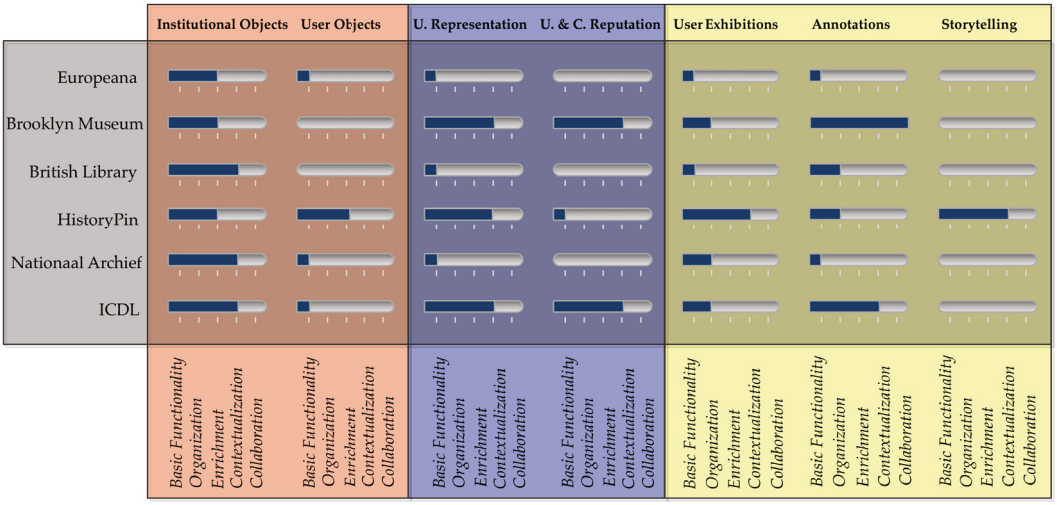

Figure 7.1.: Comparison of interactions of all systems, red are the *Content* classes, blue the *Support* classes and yellow the *Curation* classes. The blue status bar indicates the degree of interaction per class with a full bar representing *Collaboration*.

each class (blue status bar) and gives an overview of the system's interaction degree in comparison to the other systems in a class. The red square represents the *Content* classes, the blue one the *Support* classes and the yellow one the *Curation* classes. All systems focus on representing their objects, a couple of them have *User Objects*. Interactions in the *User & Content Reputation* class only occur in half of the systems. All of the systems offer some form of *User Representation* - often in the form of a user account, and they provide at least one curational activity for the users. Only one of the systems implemented interactions in the *Storytelling* class. Each of the systems allows users to organize their items either in a private area or for sharing it with others (*User Exhibitions*). Interactions in the *Annotations* class were also implemented by all six systems. The consequences for each system will be further analyzed in the coming sections.

7.1.1. Brooklyn Museum

The Brooklyn Museum is an art museum in New York that hosts approximately 1.5 million works. In the museum domain, it is known for its unconventional exhibitions involving the user and pioneering participatory design. This is also visible on

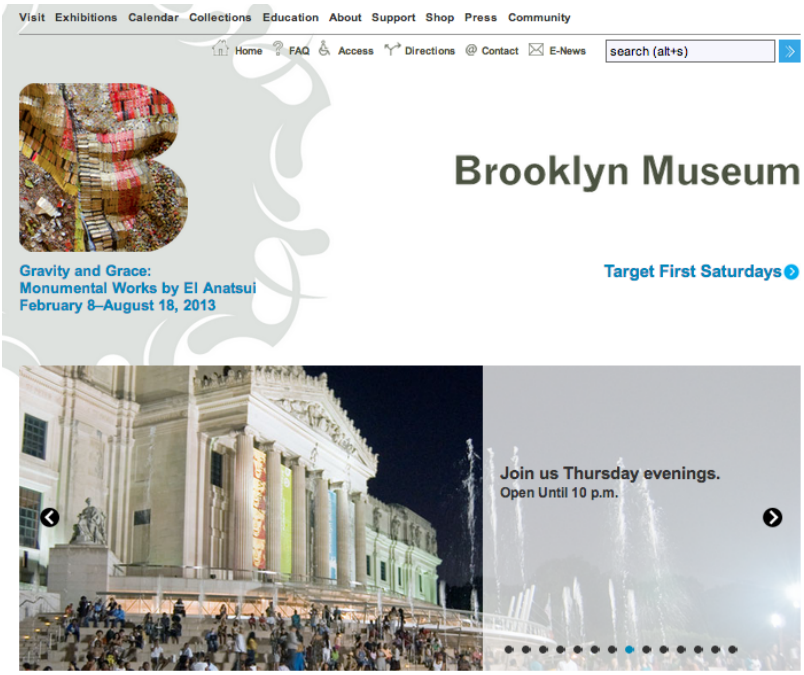

Figure 7.2.: Screenshot of homepage of the Brooklyn Museum.

the museum's website, which offers many engaging features and an online community around the art works of the museum (figure 7.2). Owing to the focus of its information system on social interactions, the Brooklyn Museum is, besides the *Museums* group, also part of the *Community* group. It is trailblazing social interactions in the information systems of the museum domain especially with regard to social tagging and how to implement an effective social tagging system (e.g. Vliet & Hekman, 2012).

Evaluation of Interactions

Figure 7.3 shows the Brooklyn Museum in comparison to the groups it belongs to. The first spider graph shows the interactions of the Brooklyn Museum mapped to the framework and compared to the average[1] of the *Community* group. The spider graph on the right shows the comparison of the Brooklyn Museum to the *Museums* group. The interaction class *Institutional Objects* has the level *Enrichment*, as the museum offers searching and browsing of its objects. Furthermore, as it is often

[1] The median for each group was calculated. For systems with no interactions in a given class, the value considered was 0.

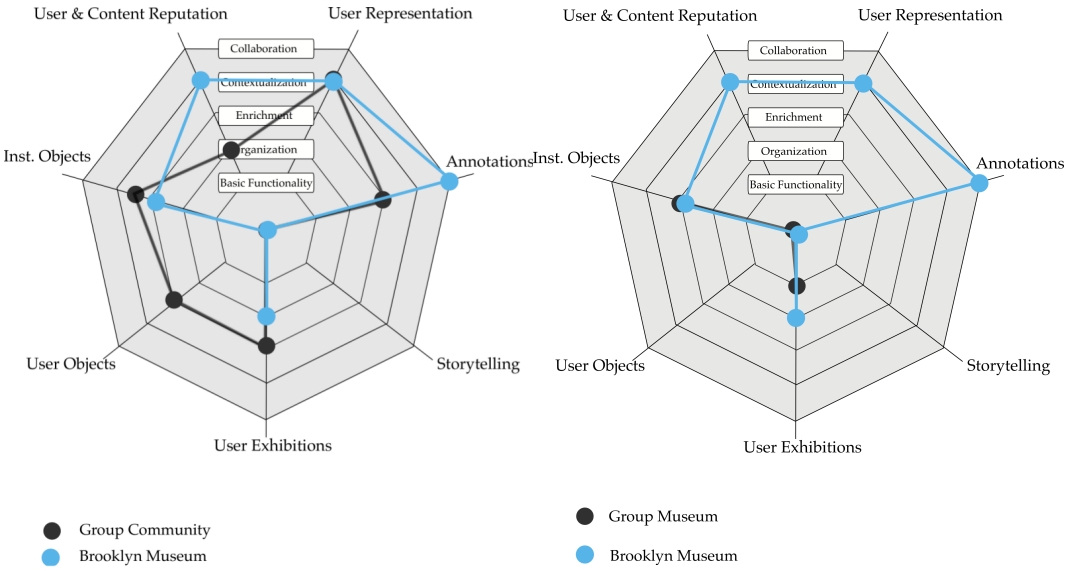

Figure 7.3.: Radar graph of the Brooklyn Museum compared to the *Community* group (left) and the *Museum* group (right).

the case in cultural heritage systems, users can explore content with curated exhibitions coming from professionals. Typical for the group of *Museums*, the Brooklyn Museum does not allow users to upload their own material. The system is designed to showcase the museum holdings and educate users about the authority content.

Nevertheless, the Brooklyn Museum is strong in social curation, as it offers users interactions in the classes *User Exhibitions* and *Annotations*, which reveals similarities to the other systems in the *Communities* group. Compared to Europeana, both the *Support* class and the *Annotations* class are well developed, reaching either the level *Contextualization* or *Collaboration*. Users can save their favorite objects and make these saved lists public on their user profile (class: *User Exhibitions*, degree: *Contextualization*). The museum created a sophisticated tagging system, which is embedded into its online community, called 'Posse'. Every user can add tags to an object, and the relationship between users, tags and resources is transparent on each of the landing pages. This means that on the object page, one can see which tag is assigned by which user. On a user profile, it is visible which tags this user assigned to which objects, and the tag page shows all the objects that were assigned to this particular tag. This is the perfect implementation of the threefold tagging relationship, which creates many more access points and allows users to pivot browse through the content, changing the view point on particular parts of the content as they click. The high level of *Collaboration* within the interaction class *Annotations* is

reached by allowing the community to create a folksonomy in a collaborative effort. Not only does the transparency of the system lead to a higher quality of the content, but the community can also keep the high-quality tags. Every user is able to delete tags of others, which are then considered to be 'challenged'. 'Challenged' tags are fed into a tagging game, whose goal it is to determine the eligibility of a certain tag for a resource. All the mechanisms are in place to create a useful and beneficial folksonomy that eases access to the material and lets users engage with the cultural heritage material.

One reason why this works so well is the strong presence of interactions in the *Support* classes. In both classes, the interactions reached the degree of *Contextualization*. For *User Representation*, this means that there is a publicly visible account where all the relevant interactions of a user with the content are listed. The association with their actions increases the users' sense of responsibility. This is even more supported by the transparency that is visible on the object page itself, where comments and tags by users are displayed. If users have a question about the object, curators jump in and answer it, thus adding valuable information that is also beneficial to the rest of the community. This demonstrates that user input is taken seriously and is valued. Consequently, more users participate and make an effort to contribute high quality material.

The *User & Content Reputation* class further supports the users' willingness to contribute content. Content can be liked and is automatically added to the users' profile pages. Users' favorite objects are visible for other users, which may help to boost this particular content. Very active users are acknowledged on a page or leaderboard that contributes to a user's reputation.

Recommendations

In terms of purposeful interactions and engagement of users, the Brooklyn Museum has taken many successful steps, and the community seems to be active and involved in producing a great number of social tags. Compared to other museum information systems, the Brooklyn Museum offers some well developed curational activities for the users. Their social tagging system, in particular, can act as an example for the developments of similar features in this domain.

To improve the interactions with users and benefit more from their curational activities, the Brooklyn Museum and other museums should move their focus further to the interactions in the *User & Content Reputation* class. Counting the likes that a particular object received boosts an object's reputation and acts as a recommenda-

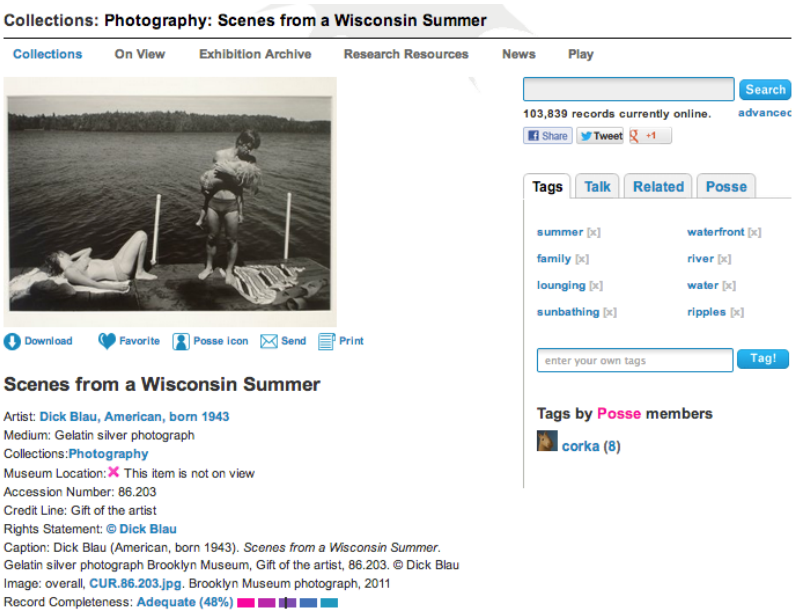

Figure 7.4.: Display of the record completeness of a particular item at the bottom of the metadata (here the level is "Adequate").

tion for users who want to explore new content. The museum's homepage could feature the most loved objects or suggest objects that were favored during the past month, week or day. Furthermore, lists created by users are often not much used if they do not have a purpose. This could be improved by featuring the users' favorite lists, allowing them to add their perspective to a particular object or theme and letting other users vote on these aggregations. In the end, it is all about making the experience more social, as this will give users some sense of purpose and control.

The Brooklyn Museum is also notable for an interesting feature on its object page displaying the record completeness ranging from a low quality level to the best quality (figure 7.4). This seems to be an internal measure that is difficult for users to understand and interpret. A possible improvement to this feature might be to make the composition of this measure transparent and let users contribute to increase this score. One element of the score could be the tags added by users. The quality of the folksonomy is rather high due to the tagging game mentioned earlier. Social tags approved by the game could be used to boost this quality score. Linking the improvement to particular users might set incentives for more contributions.

Similar to other museums, the Brooklyn Museum focuses on displaying its ob-

jects to inform potential visitors about its holdings and give them a flavor of what they can expect from a visit. In terms of social interactions and engagement of users with the digital content, the Brooklyn Museum can be considered an exception - as it offers collaboration and an online community. In general, museums can benefit from strengthening their curational activities, especially interactions in the *Annotations* class. Here, users can add value with high quality content that describes the object in a vocabulary that is more comprehensible for the novice user.[2]

7.1.2. British Library

The British Library is one of the biggest libraries in the world offering access to over 56 million items (figure 7.5). Compared to the other *Library* systems analyzed in chapter 6, the British Library offers a wider range of interactions to the users (figure 7.6). The British Library has its main focus on retrieval in the public catalog and easing its use but is also very strong in utilizing Web 2.0 applications for marketing purposes and to encourage participation (Walia & Gupta, 2012).

Evaluation of Interactions

The British Library is characterized by its focus on contextualizing its cultural heritage content. It is a good representation for other libraries as it generally takes advanced measures to add additional information to its digital objects. The British Library supplements its content with material from external resources e.g. Wikipedia. This provides an additional information layer from which users and other institutions can profit. Consequently, the library's level of interaction for *Institutional Objects* is *Contextualization*. This is one degree higher than the median of the whole *Libraries* group in this class. However, its focus is on the pure access of material and therefore the other interaction classes are underrepresented. The British Library provides interactions in the *Annotations* class in the form of tags on the level of *Organization*, which means that tags are publicly displayed and can be searched by other users. Additionally, a user account is provided where users can manage their resources and lending activities (class: *User Representations*). Here, users can also store and access items saved during their search sessions (class: *User Exhibitions*). This happens on an individual level and is not meant for sharing. Features to support collaborative efforts are minimal here, but this is due to the characteristics of a library as explained in chapter 6. The remainder of the interaction classes are

[2] As example serves figure 7.4 which shows that the user tags describe the photograph better than the curated attached metadata.

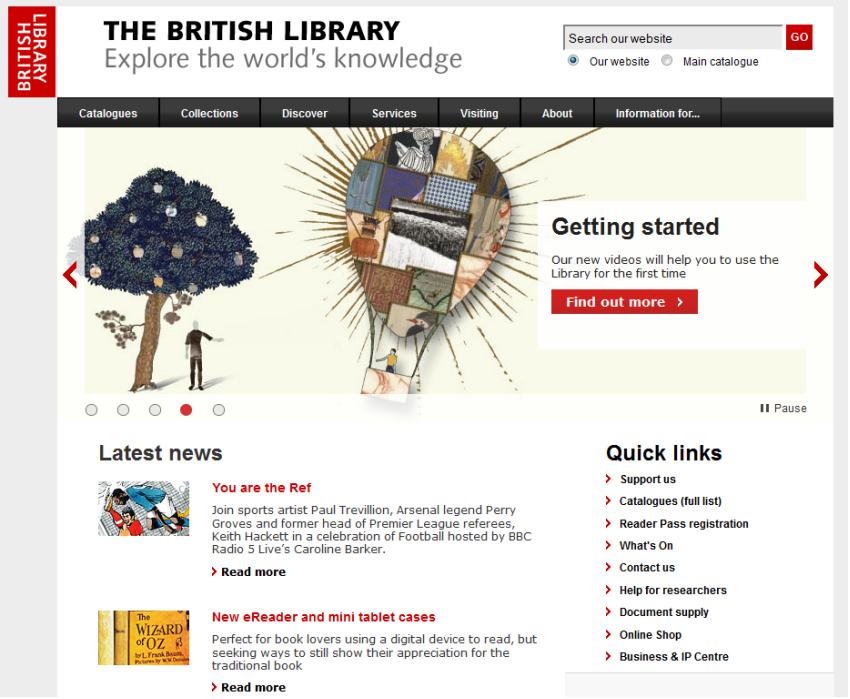

Figure 7.5.: Screenshot of homepage of the British Library.

not implemented at the British Library.

Recommendations

The British Library fits into the picture of an average library with a strong focus on interactions in the *Institutional Objects* class, but has achieved a slightly higher level than the average library due to contextualizing its items. Libraries are perfect in supporting the user in finding books they know exist or letting users browse through items related to a particular topic. Of special interest for libraries are the opportunities that arise through social use of their systems. For example, recommendations from users with similar interests make sense in this setting.

For other curational features such as tagging, the system should set incentives to encourage user contributions. At the British Library, no such incentive is given and therefore it is hard to find even one annotation or tag added by a user. A strong incentive can be provided by a public profile that makes activities of users visible and thus acknowledges them. Tags could then be used as facets to enable broader access to the content and allow users to drill down results based on these user-generated annotations. Furthermore, saved items or saved searches can be made

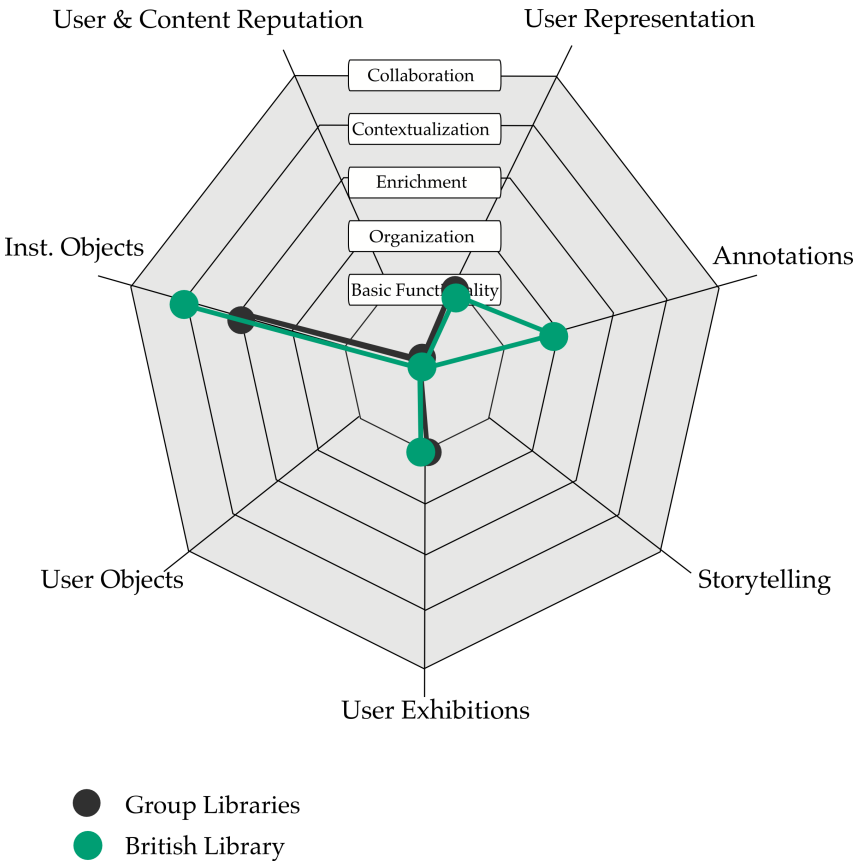

Figure 7.6.: Radar graph of the British Library and the *Libraries* group compared.

Figure 7.7.: Screenshot of information system of the Nationaal Archief.

publicly available to promote content that is popular and help users to explore unknown content based on other users' recommendations.

To make these curational activities more purposeful. it is necessary to intensify the efforts in the *Support* interaction classes. The creation of public user profiles allows to discover like-minded people whose recommendations might be a valuable asset to engage users with the library content.

Unlike the other cultural institutions, libraries have a big advantage they can leverage to build powerful recommender systems - data about lendings. This information can be easily used to group material based on interests and offer users related material for their searches. Not many libraries are making use of this advantage, but it will become a crucial element in future.

7.1.3. Nationaal Archief

The National Archive of the Netherlands hosts documents and information regarding the Dutch history. The redesign of the website in 2012 resulted in a very engaging and modern system that relies on user contributions for several parts and aspects of the presented data (figure 7.7).

In this regard, the Nationaal Archief stands out from the group of archives (fig-

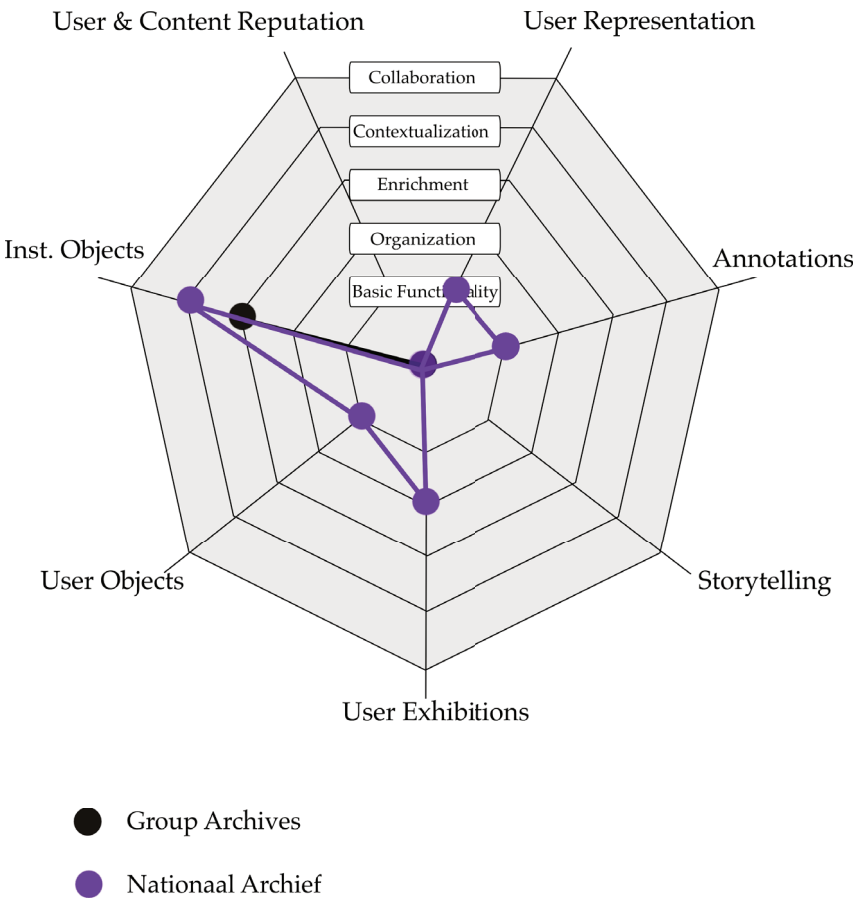

Figure 7.8.: Radar graph of the Nationaal Archief and the *Archives* group compared.

ure 7.8). The National Archief is shaped by the enormous effort it takes to digitize archival material, focusing its attention first and foremost on these challenges rather than user interactions. Most archives have not reached the point of offering access to their finding aids online, let alone providing access to their massive amount of documents. Archives are in a phase where they are still trying to figure out how to display their hierarchical finding aids in a user-friendly way and how to provide meaningful access to the shear amount of data they are storing. The Nationaal Archief already took a step ahead by offering an impressive number of interactions and involving users in transcribing archival material.

Evaluation of Interactions

The archive reached the *Contextualization* level within the interaction class *Institutional Objects*. Within the group of *Archives*, Archief Nationaal is the one with a high degree of interactions for *Institutional Objects*, namely *Contextualization*. Not only does the system offer curated exhibitions, it also contextualizes its content with external resources. Furthermore, it allows some form of *User Objects* by permitting users to transcribe documents that exist in hand-written from. The goal is to improve the existing content and make it accessible and retrievable. Within the curational activities, the archive provides interactions in the *User Exhibitions* (degree: *Organization*) and *Annotations* classes (degree: *Basic Functionality*). These activities are mainly focused on participation on an individual level and lack a social or collaborative component. The main goal is the support of personal management of the resources, e.g. with tags. Both types of interaction function more on an individual level than a collaborative one. This is mainly due to the form of the *Support* interactions classes. There are no interactions in the *User & Content Reputation* class, and the interactions in the *User Representation* class reach the level *Organization*. The Nationaal Archief provides an account where users can log in and customize their experience and store their tags, but it has no social or collaborative component to it. Again, this is very similar to other archives where the user account mainly functions as a personal space for managing services and objects offered by the respective archive. The Nationaal Archief does offer storytelling but it is separated from the rest of the resources that can be found in the information system evaluated and therefore was not considered here. It collects stories of users whose family members were part of the National-Socialist movement in the Netherlands with the main content being contributed by users (Conrady, 2012). The storytelling project[3] does visually connect to the archive but the user-contributed resources are not searchable in the main system.

Recommendations

As mentioned in chapter 6, archives have a lot of material that is potentially interesting for the general public and can consequently be monetized. Therefore archives benefit from creating user accounts for processing transactions and letting users manage their documents. The social aspect of user accounts is always desirable but not necessary here.

Furthermore, to achieve a higher rate of contributions, users who provide quali-

[3] http://hetverhalenarchief.nl/ last access: Oct 10, 2013

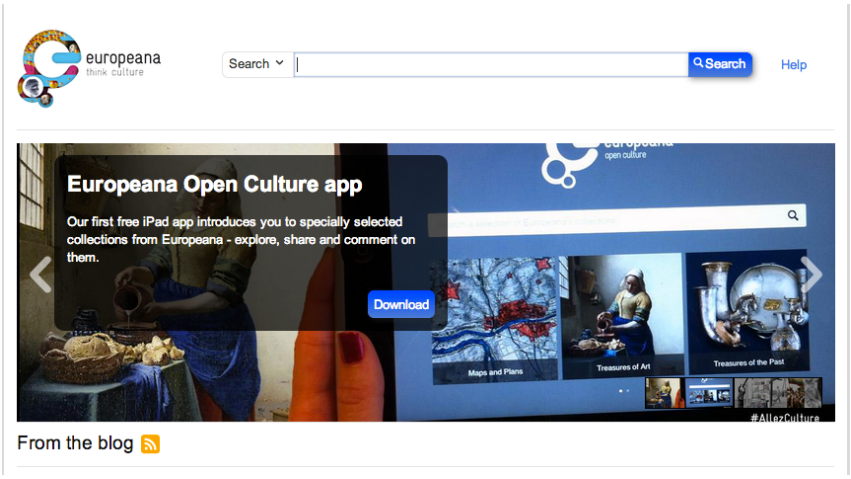

Figure 7.9.: Screenshot of homepage of Europeana.

tative transcriptions could be acknowledged publicly. This would mainly mean to strengthen the *User & Content Reputation* class.

To increase interactions overall, the *User Representation* class needs to be extended. This could happen by providing publicly available user profiles that transparently list the activities of a user. Such a profile would encourage high qualitative contributions and ensure that users are integrated into a community.

The user-contributed data from the storytelling project should become part of the resources users can search for on the portal.

7.1.4. Europeana

The Europeana portal offers a single access point to the digitized cultural heritage coming from museums, archives, libraries and galleries in Europe (figure 7.9). It is an aggregator that provides access to the metadata of the objects and a thumbnail and refers the user to the hosting institution to access the digital object in full size or the full-text of the required document.

Presently, Europeana aggregates over 29 million objects[4] coming from thousands of different European institutions. This aggregation of digital cultural heritage data is unique in its scale. Not only does it unify millions of heterogeneous digital cultural objects, but it is also characterized by an Europe-wide collaboration of providers, researchers and other stakeholders whose goal is to enable access to

[4] 29,637,274 on October 2, 2013

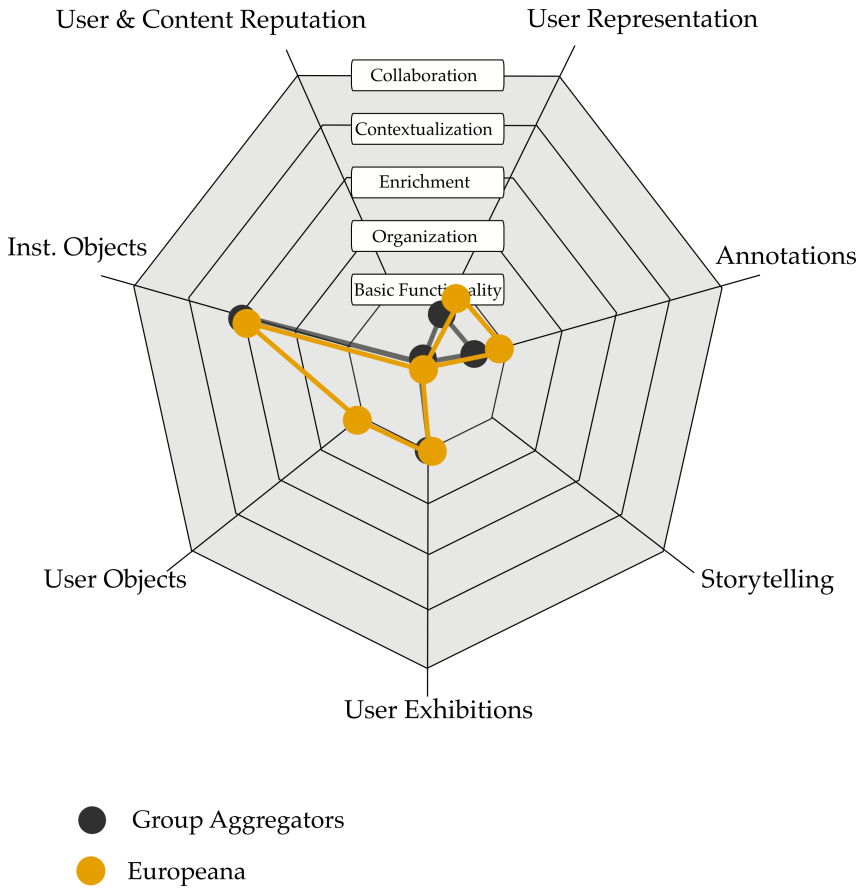

Figure 7.10.: Radar graph of Europeana and the *Aggregators* group compared.

Europe's cultural heritage. Europeana fosters research in the area of digital cultural heritage and is pioneering new approaches to improve access, for example in contextualizing the material by semantically enriching the metadata (Isaac, 2013). Several releases of the past year improved usability, visibility in search results and overall access of the material (Purday, 2011).

Evaluation of Interactions

A visualization of Europeana's interactions in the framework can be found in figure 7.10 compared to the *Aggregators* group. For none of the interaction groups, Europeana reaches more than the *Enrichment* level. The biggest task Europeana is facing is the aggregation of heterogeneous data created without cross-institutional standards. This data needs to be homogenized to offer equal access to all objects and ensure transparency. Therefore, Europeana pays particular attention to ag-

gregating the data, while presentation, display and engagement are of secondary concern. This is shown in the degrees of their interaction classes. Interactions in the *Institutional Objects* (Degree: *Enrichment*) are higher developed than in the *Curation* classes where the degree does not exceed *Basic Functionality*.

Europeana offers search and browsing functionalities for its users to find and discover *Institutional Objects* and *User Objects*. For example, it has curated exhibitions that highlight parts of the collection and tell a story about a specific topic. Furthermore, the standardized metadata fields are used as facets that allow the user to refine search results. The fact that Europeana enriches its metadata with external multilingual vocabulary allows the user to find more objects even if they are described in languages users do not understand.

Europeana strives for the integration of objects contributed by its users. The different satellite projects funded by the European Union (EU), which contribute technology, content and expertise to Europeana, aggregate user content and find ways to engage the users with cultural heritage. Several storytelling platforms were created that target different themes and invite users to tell their stories and upload their material (e.g. Europeana 1914-1918). Some of this content finds its way into Europeana where it can be searched by default with the opportunity to exclude it from the results via a tick box (figure 6.23). Search is enabled for user objects, but no upload functionality is offered, so the degree of *Basic Functionality* for the class *User Objects* is reached. User contributed objects serve as additional content source for Europeana, yet this content is only aggregated but not created on the platform.

In the *User Curation* section of the interaction classes, Europeana is rather weak. One reason is that Europeana does not store the original digital objects and can only present thumbnails that limit interactions. Users can annotate objects and save favorite items, but they are hidden in the users' private area, and these features have no social component associated with them. Therefore, the level for *Annotations* and *User Exhibitions* is *Basic Functionality*. These low levels can be explained by the interactions in the *Support* interaction classes. Europeana offers a user account which falls into the class *User Representation* but has no other functionality than to set preferences and to edit saved lists of objects and tags. This private area called 'my Europeana' stores user data but lacks a social dimension; thus users cannot present themselves in a profile or similar. This equates to the degree of *Basic Functionality* in the class *User Representation*.

Interactions in the classes *Storytelling* and *User & Content Reputation* are not implemented in Europeana. As shown in figure 7.10, Europeana represents a typical

aggregator with regard to its interactions. It concentrates on the aggregation of data and access provision on a large scale. Therefore, the implementation of curational activities is on a low level. Several problems need to be solved before these curational activities can be further developed. For example, there is yet no way of feeding changes in the metadata back to the source data as Europeana does not own the data.

Recommendations

Although Europeana does not aggregate the original source data, there are ways to improve user interactions and construct better models to serve users and institutions alike. First, interactions within the *Curation* interaction classes, i.e. *User Exhibitions* and *Annotations* should become social, so more people can profit from other users' tags and saved searches. A first step here might be to make user annotations publicly visible or allow users to share them with likeminded people in social networks or within Europeana.

Similarly, the tagging feature needs to improved within the *Annotations* class. For now, each tag creates one entity consisting of one digital object with one or more tags. Adding another tag to the same object creates a separated object that is not related to the previous one. This construction makes it impossible for users to manage their tags and the tagged objects. This limits the use of the tags if they become part of the metadata at some point.

Furthermore, the existing user accounts, interaction class *User Representation*, can be used to personalize the users' experiences and enable them to set preferences that influence the search experience. Multilingual preferences can be offered that would allow searching a collection in a specific language or automatically translating all results to the users' preferred ones. Overall, a customization and personalization of the search experience is advisable.

As aggregator, Europeana should focus its efforts on improving the interactions in the *Institutional Objects* class by embedding the content into broader contexts thus allowing users to experience it from different perspectives. Aggregators display the objects of several hundreds or even thousands of individual institutions. This offers the opportunity to display objects from different viewpoints and create relationships an individual institution cannot establish. Due to the thematic heterogeneity of the providers, aggregators can highlight the different dimensions of one topic. For that, it is essential to further enrich the metadata[5] to be able to

[5] A study on the semantic and multilingual enrichments of Europeana has shown that they can be

regroup objects based on other characteristics than their creator, title or providing institutions. Bearing in mind that the most valuable asset of aggregators is the data they are providing, their core task is to improve the accessibility of these objects by creating links between them that would not have been possible in the providing institution. The providing institutions often only present their views on the collections they are storing, an aggregator has the perspectives of several institutions on the same topic or object. Linking these perspectives can lead to a richer contextualization of objects.

7.1.5. Historypin

Historypin is a *Community* system that lets users upload historical photographs, tell stories about them and map them to a certain geographic area (figure 7.11). The goal of Historypin is to strengthen local history and bring people from different generations together sharing their history and thereby creating the biggest archive of human history [6]. The system is used by the general public and as well as institutions like museums, libraries and archives. The content of both types of users is not treated in a different way although measures are taken to easily identify landing pages and the associated pins of authority institutions.

Evaluation of Interactions

Historypin belongs to the group of *Community* systems with a strong focus on social interaction and participation. This is also visible in the evaluation of interactions (figure 7.12). With regard to interactions belonging to the *Institutional Objects* class, Historypin achieves a degree of *Enrichment* similar to Europeana and the Brooklyn Museum.

Historypin has a strong focus on user-generated content, allowing users to upload their material and blend it into all services of the system. Material coming from institutions and objects contributed by users are treated the same. Consequently, the system reaches the level *Enrichment* in the *User Objects* class.

The site is also very strong concerning interactions in the *Curation* interaction classes. In the *Annotations* class, Historypin has implemented interactions up until the *Organization* level. Users are allowed to tag their content and search it, but they can only tag their own resources. The other interaction classes, *User Exhibitions* and *Storytelling*, are well developed and reach the level *Contextualization*. User-

misleading and erroneous if no enrichment strategy is applied (Olensky et al., 2012).

[6] http://www.historypin.com/faq/ last accessed October 10, 2013.

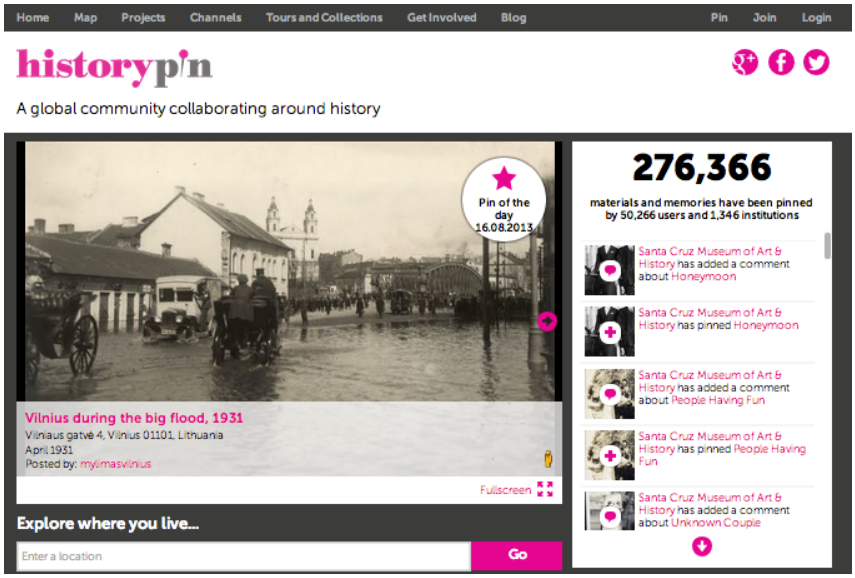

Figure 7.11.: Screenshot of homepage of Historypin.

generated objects and the stories formed with them can be embedded into a rich layer of information. Users can add locations and additional texts and material. Historypin is very strong in its *Storytelling* feature, which permits users to aggregate items in a chronological order that can then be viewed by others in a slideshow modus. Historypin also stands out in the implementation of curational activities. It is very focused on creating a visually rich experience that aims to encourage sharing. Other systems in the *Community* group also have a strong commitment to social interactions, but they do not combine it with such a high number of curational activities.

The intense focus on curation is reflected by the interaction class *User Representation*, which for this system is at the level *Contextualization*. The whole system is designed with social interaction in mind, which involves enabling users to follow the activities of other users and comment on them. The profile, here called 'Channel', permits users to customize their experience in the system and personalize how they present themselves to other users. The user channels are the aggregation points for all public activities where objects marked as favorites, uploads, tours and collections can be seen by other users. Contrary to this, *User & Content Reputation* interactions are available only in a rudimentary form, at the level *Basic Functionality*. Users can favorite objects that are then part of their favorite lists. The favoring of an item has no influence on its presentation, and on object level it is

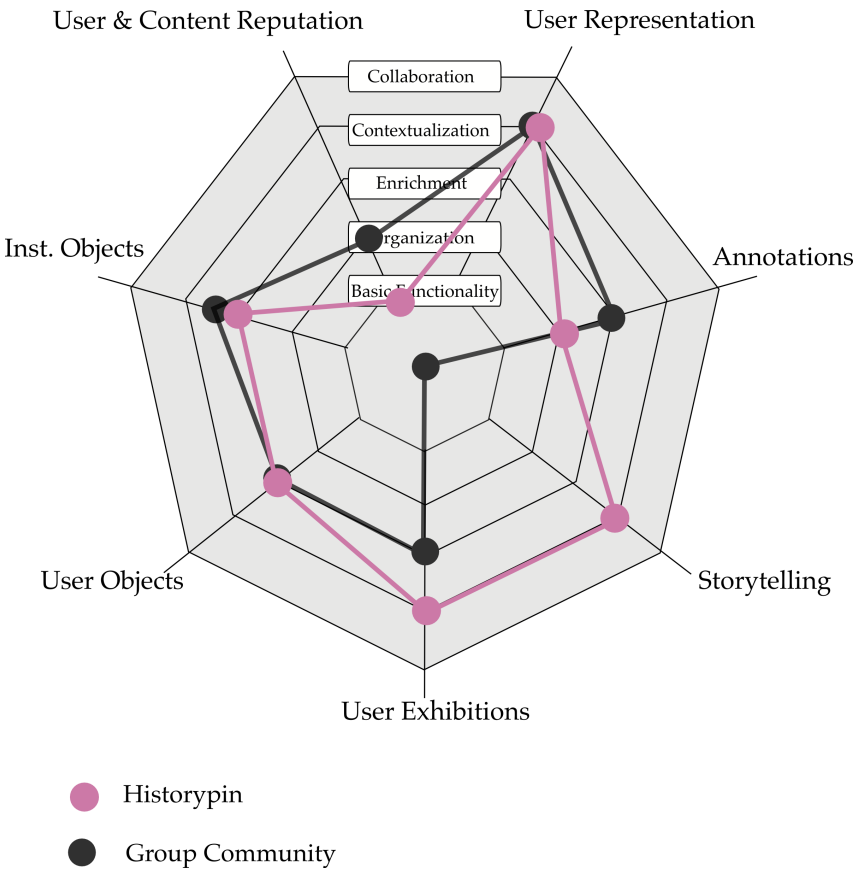

Figure 7.12.: Radar graph of Historypin and the *Community* group compared.

not shown how often an object is liked. Historypin implements similar means to measure the popularity of an item. They show the number of views an object has had over time and push certain objects by displaying a 'pin of the day' picture on the homepage.

Historypin has developed into an interesting playground for memory institutions to showcase their collections and reach different and broader audiences. It partners up with these institutions to provide even more authoritative content in its system. From a user's point of view, this application offers an interesting way to engage with cultural heritage content, as it enables them to leave comments and use the content for their own tours or exhibitions. In contrast to user-generated content for institutions, comments about institutional objects made by users in Historypin are lost for other users who might use the authority's system. Again, for institutions participating in Historypin, there is the trade-off between outsourcing the user engagement to third-party web systems and losing the context users built around the objects in these systems. Nevertheless, this option is cheap and takes interactions to places where users are already creating engaging content. Therefore, it is often easier to engage users on a third-party site than trying to built up a community from scratch.

Another area of improvement for Historypin could be their focus on the single user experience. Users can engage in many activities on the website but these have little effect on the overall content of the system. Here, it would be desirable to let users improve and contribute to existing content and make it part of the knowledge base.

Recommendations

In order to achieve more user engagement, it would be very valuable for users to see how often an item was favorited by other users and in which tours and collections it was used. This would add another layer of context to each object and more access points to objects could be created (users using the object in their activities). Furthermore, this would add more weight to objects through community acknowledgement.

Another option is the collaborative editing of content. For now, users have the possibility to add comments to an entity within the system but they cannot add tags or other contextual data. A link leading to an email form suggests that users can provide more accurate data and states that the information will be approved and is not available instantly. Encouraging users to contribute more accurate data could

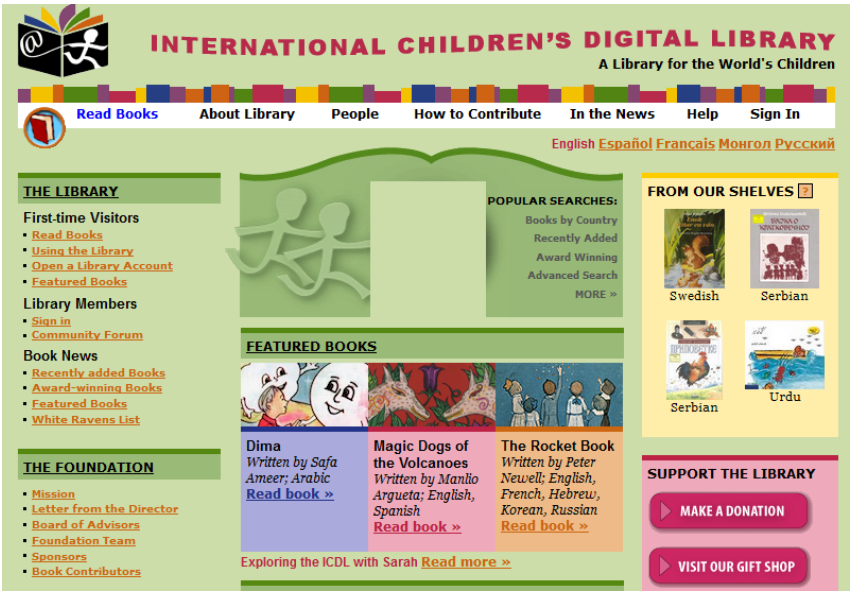

Figure 7.13.: Screenshot of homepage of ICDL.

be achieved by making these contributions visible to other users. In addition, the collaborative aspect of tags could be used to a greater extent, which would support the creation of a folksonomy (class: *Annotations*).

In general, institutions can learn from systems in the *Community* group. Their focus on collaborative curational activities seems to pay off through high quality user-generated content and thus more access points to explore it.

7.1.6. ICDL

Initiated in 2002, ICDL's goal was to create a collection of children's books in 100 languages, having kids as its main audience in mind (Hutchinson et al., 2005) (figure 7.13). It has currently 4642 books in 61 languages and also presents a real-life use case for different research questions such as cultural differences in information systems (e.g. Souza et al., 2008), multilingual information access and children's access to information on the internet (e.g. Hutchinson et al., 2007).

The ICDL belongs to the *Collections* and *Libraries* groups as it has characteristics of both of them. This categorization is justified by the fact that the ICDL offers access to books and their content with a specific theme.

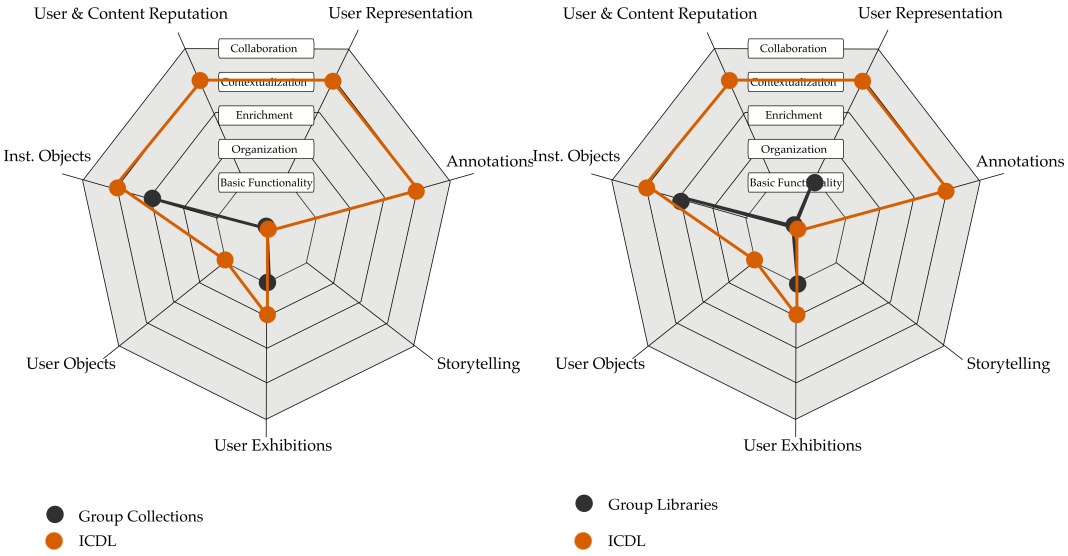

Figure 7.14.: Radar graphs of ICDL compared to the *Collections* group (left) and the *Libraries* group (right).

Evaluation of Interactions

The ICDL is a well-implemented digital library that is characterized by a deep understanding of user interactions and how to use them for an engaging user experience. Figure 7.14 shows the radar graph of the interactions of the ICDL and the interactions of the groups it belongs to.

For the interaction class *Institutional Objects*, the system has the level *Contextualization*. It provides search and browsing functionality and offers some facets that enable children to explore the content. Rather than relying on the classical library metadata fields, it provides facets that are much more relevant to children who want to identify books they know. For example, the color of the book cover is one facet, and the search can be further narrowed down by emoticons that express the feeling a book creates, such as happy, sad or scary (figure 6.30). Additionally, the system offers predefined collections that are curated around a specific topic. The objects have exhaustive descriptions and are enriched with users' reviews and links to libraries where they can be borrowed. The ICDL also links any curational activity in which the book is involved to the landing page of the particular book. This contextualization is rarely found in other cultural heritage information systems. Thus, the user gets even more contextual information by being informed that this particular book is part of a curated exhibition. Making this relationship between the curated content and the children's books transparent to the user is very bene-

ficial. It ensures contextualization of the content and lets users also explore other content based on the theme of the exhibition and branch out to interesting curated content.
The ICDL allows users to upload their own objects. These are not books but drawings depicting themes from existing books. The drawings can be added to an existing digital object and are not digital objects themselves. Therefore, the level reached for *User Objects* is *Basic Functionality* as an upload function can be used.

In the curational classes, the ICDL offers interactions in *Annotations* and *User Exhibitions*. For the *User Exhibition* class, it allows users to aggregate favorite items in a list that is then accessible for other users on the profile. Therefore, the level of interaction reached here is *Organization*. In addition, users can add books to their private shelf for future reference. In the *Annotations* class, the system gained the level *Contextualization*. The ICDL does not only allow users to tag books, but to add their own reviews to the books and contextualize them with the drawings they created. These annotations and the objects reviewed are visible on the users' profile pages. Several access points are created through the system and the user gets the opportunity to browse content based on reviews and ratings of other users and their recommendations.

Recommendations
The ICDL is represented in two groups due to its characteristics of offering books to its target audience of children (group *Libraries* and group *Collections*). The whole system is focused on the content of the books and users exploring books in languages they might not speak. With this regard it also has a focus on social aspects with the aim of building a community around these children's books. This social aspect of the curation could be intensified. For example, when kids upload their pictures about the books they are reading to the digital library, it would be beneficial if other users could comment on or rate these drawings to acknowledge the hard work that went into creating them. Another possibility could be to encourage the creation of drawings around the themes of the digitized books. Furthermore, the drawings are only accessible as add-ons to reviews written for a particular book. The user reputation within the community could be strengthened by creating access points for these drawings. Other users might choose books to read based on these browsable drawings. Using these drawings as access points to the material could be a valuable additional asset.

7.1.7. Summary

In the previous section, it was shown how the framework can help to evaluate a cultural heritage information system. This evaluation derived recommendations that - when implemented - could serve users and institutions alike. The framework shows at a glance where a system has its weaknesses and its strengths and how this is related to accessing the material stored in the particular system. It also allows comparing systems and seeing where they differ and where they overlap in the presentation of the content and the engagement of the user.

Figure 7.15 shows the visualization of a comparison of three systems that are very similar with regard to their characteristics, namely the British Library, Europeana and the Nationaal Archief. It is immediately visible which interactions classes dominate the overall interactions of a system and which are of lower impact. The comparison can also help to quickly identify potential solutions to weaknesses and see what other systems might have done differently. The figure shows that the interactions in these three systems have several commonalities: focus on the interaction *Institutional Objects*, a user space for personalization with no social dimension and provision of tagging functionality (class: *Annotations*) and saving of objects (class: *User Exhibitions*) for individual document management.

A completely different picture is presented in figure 7.16 which shows a comparison of Historypin, ICDL and Brooklyn Museum. Their commonalities lie in a strong focus on the *Support* interaction classes and especially *User Representation*. Furthermore, all systems implemented one or more interaction classes from the *Curation* interaction classes to the degree of *Contextualization* or even *Collaboration*.

7.2. Results and Recommendations for Purposeful Interactions

In the following section, the results of the analysis will be raised to the next level by giving generalized results and formulating recommendations for interactions in cultural heritage information systems. This section will list concrete results and recommendations to inform an effective system design strategy that was derived from the evaluation in the previous section. The recommendations are targeted towards administrators, developers, designers, and professionals who guide the development process of cultural heritage information systems. The following outcomes derived from the content analysis and the evaluation are mapped to the main ar-

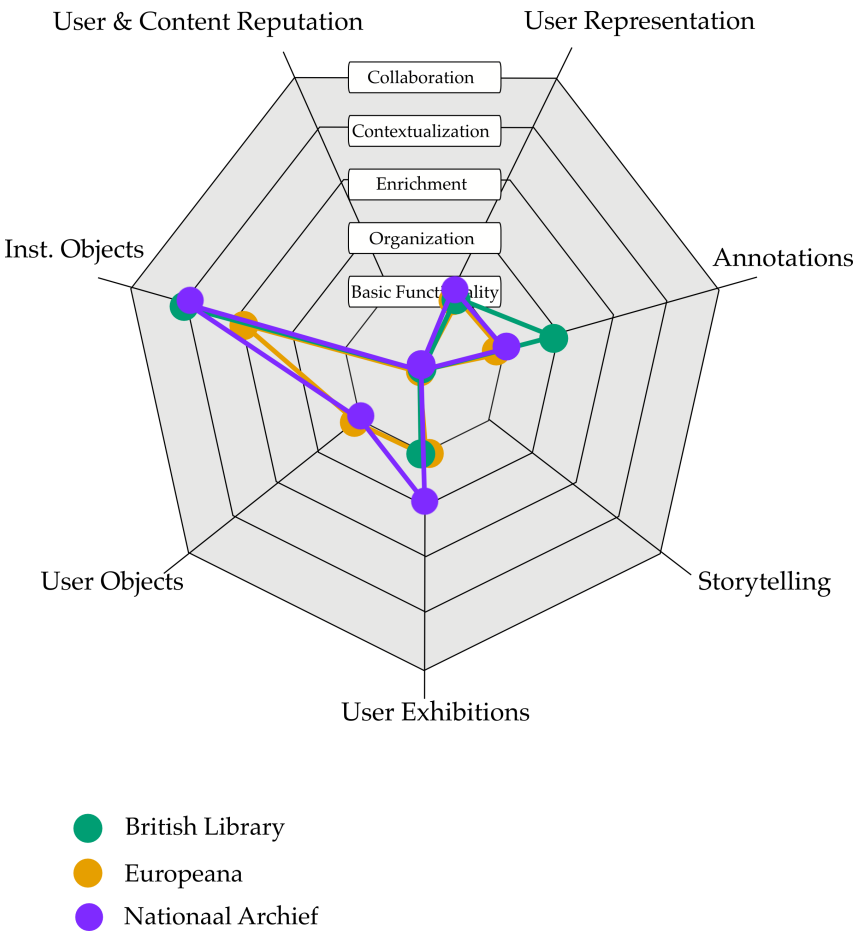

Figure 7.15.: Radar graph of British Library, Europeana and Nationaal Archief in comparison.

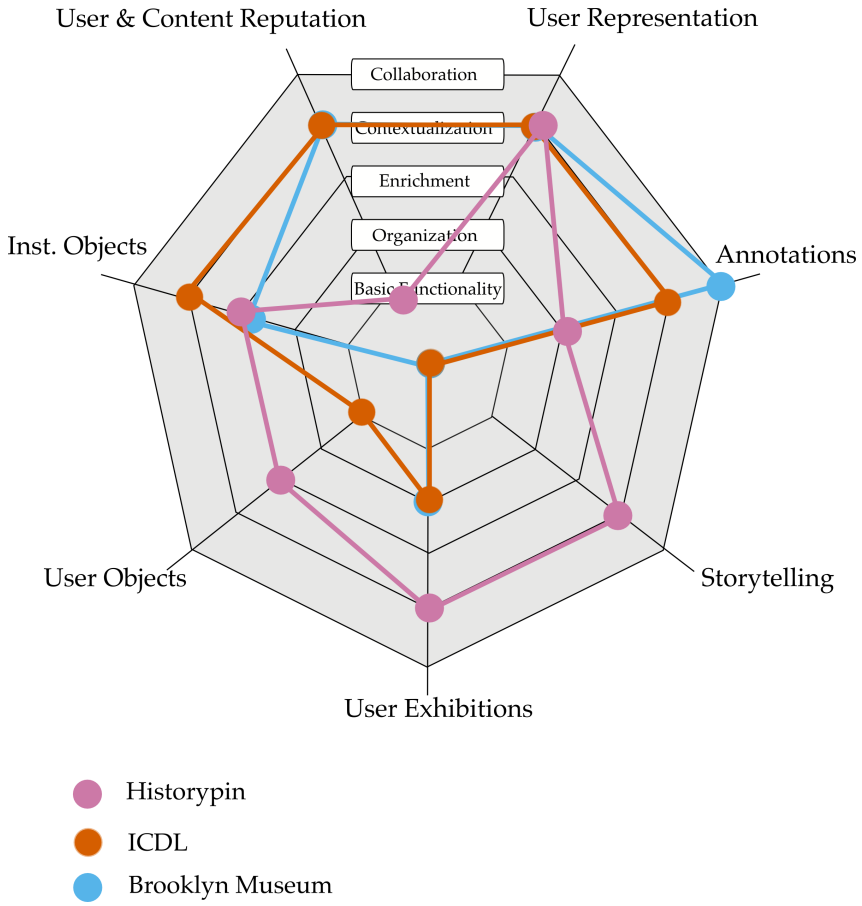

Figure 7.16.: Radar graph of Historypin, ICDL and Brooklyn Museum in comparison.

eas of challenges identified in chapter 2, namely environment, goals, content and access.

7.2.1. Environment

Community systems can guide developments.

The authoritative role of institutions still shapes the offered interactions. To overcome this, *Community* systems can serve as an example of how an integration of cultural responsibility with a community of non-experts might work out. In many cases, community systems are self-sustainable. The community makes sure that contributions reach a qualitative threshold without needing much guidance. These systems hand a lot of responsibility to the user. Generally, they do not originate from memory institutions but are hosted by private parties or other non-profit organizations. The amount of freedom community systems offer their users might spook traditional institutions.

Digital cultural heritage changes the form of the cultural record.

Another consequence of this research can be to understand digital cultural heritage objects as independent cultural heritage objects detached from their physical counterpart. The objects acquire meaning and context through the digital interactions and manipulations that happen when they are viewed, commented and edited by users. It is clear that for this to work, the revision history and provenance of changes need to be tracked. To prepare for shaping cultural heritage objects online, institutions have to be aware that they need to know exactly who commented on what objects at which time. Any alterations to the digital cultural heritage object should be documented.

Differences in hosting institutions are visible in offered interactions.

The analysis showed that each group of cultural heritage information systems has its unique interactions that often originate in the organization system and the mission of the hosting institution.

New dissemination channels are created.

Archives can serve as a good example of memory institutions that highly benefit from digitizing their content and finding new channels to engage users. Before the digital revolution, archives were mainly used by historians. Now, with remote access to highly valuable documents, the public becomes an

interesting stakeholder in developing these systems. For example, archives have become the hub for information on family history and genealogy. This is not a new task, but through the Internet many more people can be reached who are also willing to pay for these services. For the other institutions, similar opportunities might open up, which could lead to more engagement and potential revenue.

7.2.2. Goals

User curation is a social experience.

When users curate and interact with the content by adding their viewpoints and stories to it, this works best in a social setting. That ensures that users get acknowledged for the work they are doing and are motivated to contribute even more. One reason for this is the sense of belonging to a community, which matters as it conveys the impression the task on hand is worthwhile and contributes to a greater good. Curational activities should be augmented by a social component as this acts as a motivator leading to more contributions. It further ensures that content is shared by more people and is visible to a greater audience.

Collaboration is a valuable asset.

Collaboration in each interaction class helps institutions to create more access points to their content and gives users incentives to participate. Ideally, cultural heritage information systems should implement a certain group of interactions with the goals to involve the audience, to extend the links between their objects and to contextualize their presented knowledge. This should happen in line with their mission of educating and entertaining the general public. When it comes to participation features and engagement, they should strive for the highest degree of interaction - collaboration. It is striking that most museums are willing to implement some sort of Web 2.0 functionality but fail to apply it with a purposeful strategy in mind.

Activities need a purpose.

Half of the information systems that offer the user to save a favorite item of the collection lack a convincing purpose why the user should engage in such an activity. Saved objects can be accessed in a personal space such as an user account but are not accompanied by a participatory strategy. Exhibitions cannot be shared or rearranged and just function as a bookmarking list. For

users, there is no additional benefit in saving an object to a list when it could be also bookmarked in the users' browser, saving them to log into a separate site to access it.

7.2.3. Content

User-contributed objects are valuable.

If users contribute content, it should be valued and appear side-by-side with institutional content. Institutions are still reluctant to accept user-contributed material and fear a devaluation of their content or abuse on the part of the users. These apprehensions are often arbitrary, especially if a working community exists that can oversee the content. In many cultural heritage information systems, user objects are strictly separated from institutional content. Often, these are separate projects, but in some cases user-contributed data is only visually distinct from authority data but can be searched and retrieved in the same way. Valuing user data by embedding it into the institutional content can help to improve the quality of the uploaded content.

User contributions should be leveraged in different languages.

Participation and engagement of users can be leveraged to improve access across languages. For now, this is only marginally implemented in cultural heritage information system although cultural content is often multilingual and so are its users. Leveraging their language skills and match user tags, comments and other annotations across different languages should be a goal.

7.2.4. Access

Users can improve metadata quality and contextualize the content.

Users can help memory institutions to improve the quality of their metadata and access to digitized objects. This could happen by leveraging extrinsic information that is collected with an open call-to-action, such as user-contributed stories or tags or the invitation to send an email with further information on a particular object. Another option is to harness the user interactions in an intrinsic way and enrich metadata, for example with the queries that a user executed to find a particular object or by leveraging users' tags.

Search is an insufficient access mode.

Most of the institutions analyzed in this thesis still rely on search as the primary access point for their content. This excludes audiences that do not know what to find in a particular system and need guidance to discover unknown objects. Most users do not know what they are looking for in cultural heritage information systems. Browsing functionalities are more and more established, but they are based on curational activities of professionals, which are expensive and time-consuming. A solution could be to let audiences create access points through their interactions with the content. Especially within the *Engage* access mode, users create access points that can then be searched by others.

The more access points, the better.

Cultural heritage institutions digitize their content to make it more accessible and consequently reach more potential visitors. The problem is that the describing metadata does not match the requirements and needs of users. This leads to many objects staying hidden. Curated exhibitions and browsing features help users to overcome the entry barrier and offer them content they might not be aware of. Furthermore, clever use of user interactions can reveal these hidden gems and lead users to engage with digital cultural heritage while enhancing it with different perspectives. Making user interactions transparent within the system can guide other users to content they might not know. If users become an entity within the system, for example through profiles and such, they also serve as access points to content, for example through profiles that can be searched.

Professionally curated content should find its way to the source data.

Professionally curated content, in the form of extensive metadata descriptions and digital exhibitions, is highly valuable. Not only does it offer a high quality access point to learn about the material and add context to certain objects, it is also a trusted source of heritage interpretation, which is the core task of a memory institution. Often the curated content is separated from the source of the data that resides in the information system. Users accessing digital objects then do not know that this particular object is part of a curated exhibition. Linking these contextualizations of an object is highly recommended to give searchers more contextual information. Bearing in mind that institutions spend a lot of resources to curate content, it should be ensured that this

content is not hidden.

Users can boost better content.

When users interact with content, they leave traces that can be used to improve accessibility of the overall content. Simple things like the views of an object or the most clicked object can be made visible. This creates a new access point to the material and also shows new users what is worth visiting and liked by others. Especially if functionalities such as favoriting are already in use, it is easy to count the occurrences of people liking or favoring a particular object. Leader boards or most liked features are an interesting access point for users who do not know what to find in the portal and need some guidance. Another way to boost content is to let users see other people's searches.

Table 7.1 summarizes the challenges found in the literature in chapter 2 and the results and recommendations developed in this thesis.

7.2.5. Interaction Models and a Strategy for Purposeful Interactions

This thesis introduces a framework with which user interactions in cultural heritage information systems can be analyzed and evaluated. It is a theoretical approach to determine what kinds of interaction are prevailing in a given system. The results of such an analysis lead to recommendations for system design that can help shape the development of systems in future. The next step is to suggest concrete measures for implementing these recommendations.

As mentioned in the previous section, it is desirable to implement *Collaboration* in each interaction class as this ensures the creation of many access points and leads to more engagement with the content. But how would a strategy for implementing purposeful interactions look like? As an example, a social tagging feature belonging to the class *Annotations* with its interactions for each degree is presented. The results will be used to derive a generalized strategy for the implementation of purposeful interactions in cultural heritage information systems.

Implementing a Social Tagging Feature

On the basis of a tagging feature, it will be demonstrated how an implementation will look like by going through all the levels in the framework. This will show how the *Annotations* interaction class interacts and is influenced by other interaction classes. Figure 7.17 shows a tagging feature with different degrees of interactions. This feature is often implemented in cultural heritage information systems to

Table 7.1.: Challenges, results and recommendations for interactions in cultural heritage information systems.

Name	Challenges	Results	Recommendations
Environment	Changing roles	Authoritative role still shapes offered interactions	Move to participatory and collaborative culture
	Changing cultural record	Surrogates become cultural records themselves	Documentation and version control, identification of contributors
	Convergence of services	Differences between systems visible in offered interactions	Link different services
	Influences of web 2.0	Creation of new dissemination channels	Leveraging new dissemination channels
Goals	Institutional goals	Curation is still an activity of institutions, user curation is only rarely implemented	Collaboration can support institutional goals, user curation should be a social experience
	User needs & expectations	User needs and expectations rarely influence system design	Provide activities with a purpose
Content	Heterogeneous content	Unifying heterogenous content is still problematic	Value user-contributed objects
	Multilinguality	Plays only marginal role in systems	Leverage user contributions in different languages
	Metadata for experts	Unsuitable metadata dominates the object descriptions	Leverage user contributions
Access	Limited access points	Search is predominant access point	Create more access points through collaboration and user profiles
	Interpretation of cultural material	Professionally curated content and the objects are not linked	Link curated content to source data, juxtapose different view points
	Loss of context	Contextualization by users only in *Community* system	Let user contextualize the content, user can boost best content

let users tag object stored in the system. One can see the interactions for an active user who is contributing content in the form of tags to digital objects (left side of figure 7.17). From bottom to top, the degrees of interaction are represented with the boxes built on one another, starting with *Basic Functionality* and ending with *Collaboration*.

On the first level of *Basic Functionality*, there is the user who can add a tag to a resource. In this case, the tag 'coffee' is added to a picture. On this level, the tags are just for personal information management and not publicly visible. On the next level, the user can add more tags to the same object at a later stage. These tags are accumulated in her account and can now be seen and found by others as well. On the *Enrichment* level, the tagging user can disambiguate her tags as the feature is connected with external or internal vocabulary. This vocabulary can be domain-specific and based on the topic of the information system or it can serve special facets such as geographic locations or artist names. The level *Contextualization* is characterized by the tag-user-resource-relationship that is transparent. Every node can be used as pivot point to browse the content from a different angle. That means the user can explore all profiles of those users who assigned the same tag as hers or other tags to a resource.

On the last level, *Collaboration*, the user can delete tags of other people that she does not consider appropriate or fitting. Tagging games are a popular means to let users collaborate on a folksonomy and ensure a certain threshold of quality.

Apart from the active user, there is the rather passive user who consumes and benefits from the contributions other users are making. Figure 7.17 also shows such a passive user on the right side (Reader) and the experience and benefits she gains with each level of implementation. On the first level - *Basic Functionality* - this user has no benefits. All the tags assigned by other users are hidden and not accessible or retrievable for her. This changes with the second level, where tags are publicly assigned to resources. Here, the tags act as additional access points through which the tagged objects can be discovered and retrieved. Furthermore, the use of vocabulary to disambiguate the user-contributed tags also helps the searching user. In this example, she could specify if she is interested in the city Dublin in Ireland or the one in California, USA. This also enables the creation of browsing and discovery tools. For example, geographic tags can be pinned to maps to contextualize objects (degree: *Contextualization*). On this level, it is also possible to browse the tag-user-resource-relationship and regroup the data according to a pivot point chosen. The last level is characterized by *Collaboration* and the possibility to exchange

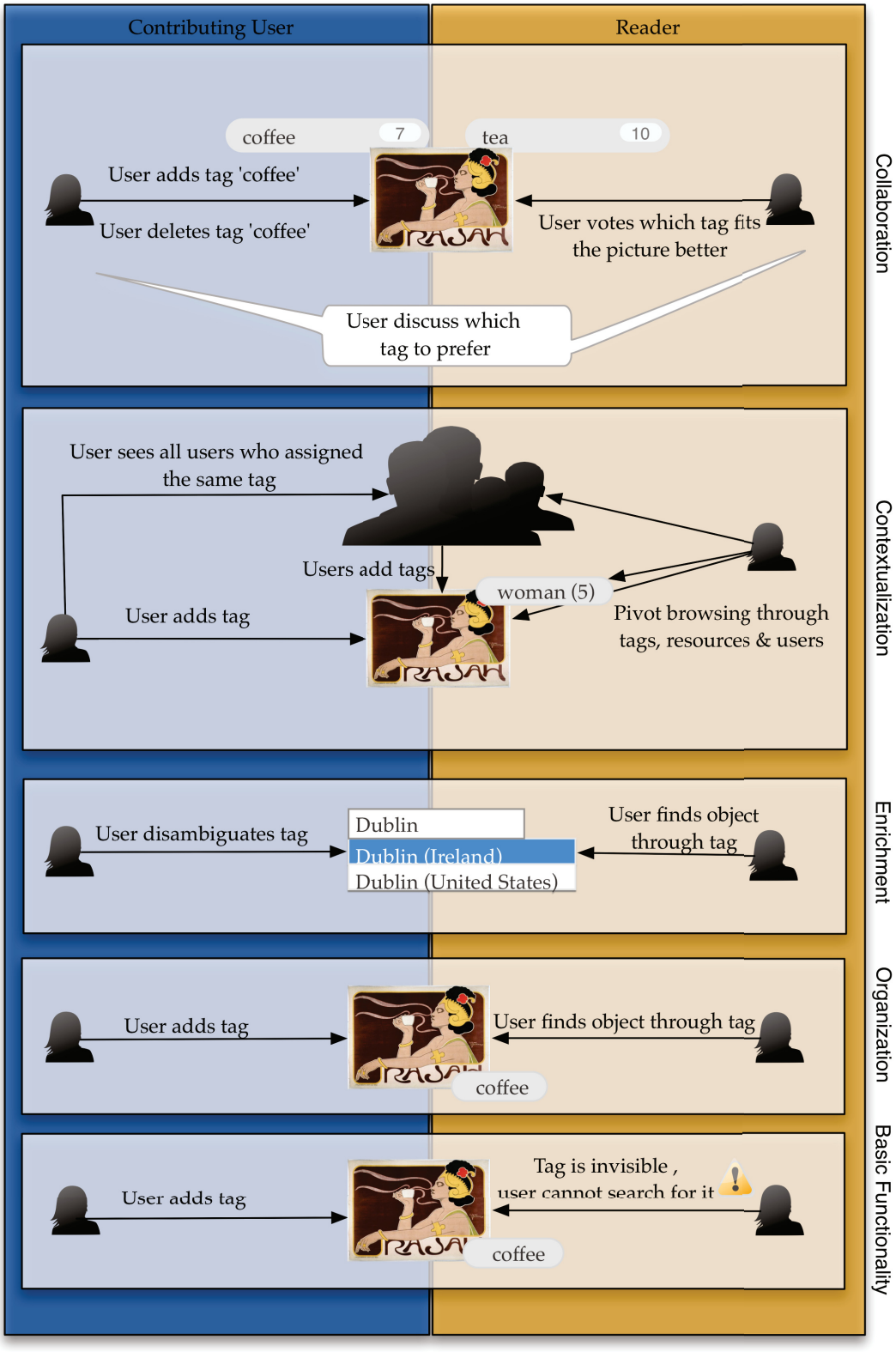

Figure 7.17.: Interactions of a tagging feature on the different interaction levels.

opinions and comments with other people and collaboratively form a folksonomy.

Additionally, one could look at the different implementation stages and raise awareness about the needed system functionalities. On the *Basic Functionality* level, the tagging module is provided and users can do simple interaction patterns like adding and deleting a tag and accessing it later in their account; it comprises the tags and an appropriate storage system. If the tags are structured, and users can browse them and they are visibly placed next to the resource, interactions from the *Organization* level are implemented. For the *Enrichment* stage, the system offers automatic features to ensure qualitative tags. This could mean an auto-completion feature or enrichment of the tags with controlled vocabulary. Additionally, the system stores tags with their appropriate links to the tagged resource and the tagging user. In the literature, this is referred to as the tag-user-resource-relationship (I. Peters, 2009, p. 39). Users can fully exploit this relationship through pivot browsing. The first three levels allow the user to search and browse the tags. Common patterns are the distinction between public and private tags and pivot browsing based on the tag–user-resource-relationship. Users are able to add complex information to the tags like descriptions, preferred terms or links. The system would also allow pivot presentation of different relations among users, tags and resources. *Contextualization* would disambiguate tags through additional information, e.g. showing geographical tags on a map. For *Collaboration*, collaborative editing of tags is implemented that comprises the ability to collaboratively determine preferred terms for tags excepting misspellings and outdated terms.

Theoretically many more interactions are possible per stage with the number of possible interactions and their complexity increasing with each level.

With each interaction offered for active users access points are created from which the more passive users can benefit. The more collaborative engagement is offered, the more users can interact with the content and with each other. Cultural institutions should strive to implement such scenarios. To achieve this, it is crucial to have a strategy that guides the system design towards purposeful interactions that serve all users. The next section illuminates this aspect in more depth.

7.3. Summary

The framework for interactions serves as a strategic guide to implement purposeful interactions. Therefore, the answer to the third research question on how the evaluation of user interactions can inform effective system design, is given. At the core of each strategy for system design should be four main assumptions that are based on the results of the previous analysis:

- The content is the basis for curational activities that are provided by the institution and utilized by users.
- The curational activities strive for collaboration through *Support* interactions.
- The more collaborative the curational activities, the more access points are created for the content.
- Additional access points for the content are leveraged through *Search*, *Browse* and *Engage*.

Figure 7.18 summarizes these points and shows the interaction classes in relation to the access modes and gives an idea how the different components influence each other.

Understanding the interplay of the different classes with each other helps to shape a strategy that addresses interactions in system design. The *Content*, *Curation* and *Support* classes are interwoven and influence each other. For successful system design it is helpful to be aware of the following points:

Content: Usually, content is at the basis of each information system and shapes the interactions built on top of it and the modes of access. It is crucial to determine what type of content in which format the information system will store and present to users. The decision for user-contributed objects leads to many more questions one has to be aware of. This decision automatically shapes the information system as it requires interactions similar to the ones that can be found in the *Community* systems.

Curation: The curational activities should match the overall goal of the system. Social tagging can be used to enrich metadata with user terms which will represent further access points to the content. If a regrouping of objects under different perspectives is desired, the institution might want to think about user exhibitions. For more free-form user curation, storytelling might be an

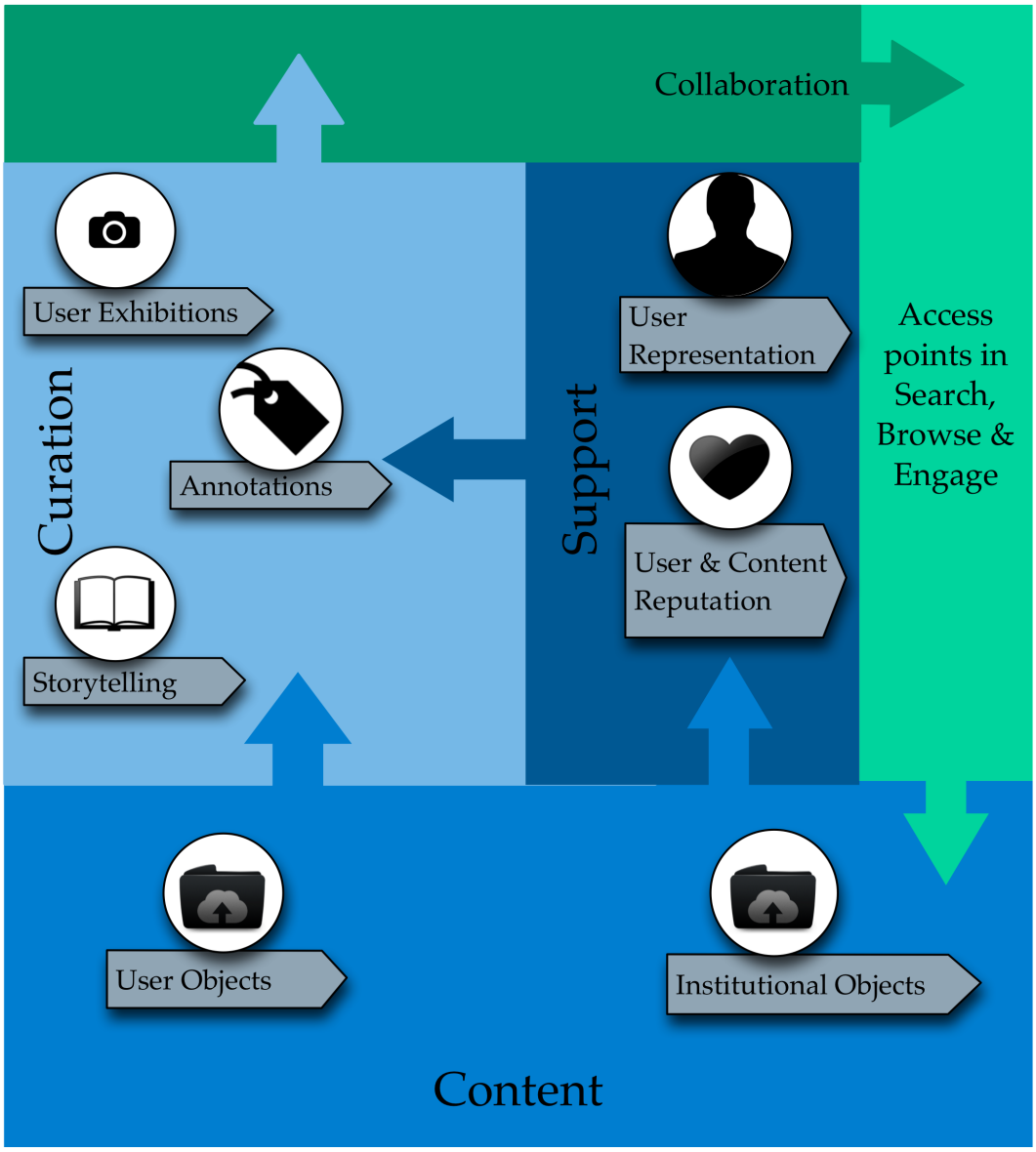

Figure 7.18.: The framework for interactions as a strategic implementation.

option. Here, the control of the institution is only minimal and it also entails to develop complex workflows to make storytelling usable and compelling. If there is no commitment to user-generated content, curational activities should not be implemented. Half-hearted implementations might impress at first, but they will not attract committed users or build a sustainable community.

Support: The success of the curational activities depends on the effort that is put into this area. Incentives need to be determined that will make users want to participate. These incentives have to be transparent and need to be accompanied by acknowledgment of the users' contributions. Another aspect here is to give users the opportunity to customize their experience and adapt it to their needs. This includes a user profile or another personal space for users to present their skills with regard to the system's topic.

The discussion around these aspects will greatly influence the system design and has implications on the technology used and the skills needed to maintain such a system. For example, the decision to allow user-contributed objects entails a document uploading system. It also requires policies on what is suitable content that can be uploaded and how to react if people abuse the system. Being aware of the different components *Content*, *Curation* and *Support* will help institutions to formulate a strategy and to understand how each decision influences the design and interactions of the overall system.

In general, each cultural heritage information system wants to offer the best possible access to its content. Search is a deficient solution to this problem. Institutions want users to explore content they do not know and discover relations they are not aware of. For this, adequate browsing functionalities need to be in place. To provide purposeful interactions, it is crucial to understand the interplay of interactions and develop a coherent strategy for system design that considers the institutional goals.

CHAPTER 8

Conclusion

This thesis describes the user interactions with digital cultural heritage and their ability to broaden and ease access to cultural material. This includes the changing role of cultural institutions and their strategies to provide users with means for purposeful interactions with digital cultural heritage while maintaining their mandate to offer universal access to curated content. Therefore, a conclusive framework to describe interactions and critically analyze them with regard to serving users and cultural institutions alike was developed. This systematic approach supports the assessment of interactions with digital cultural heritage in their entirety. The objective is to share insights about the nature of purposeful interactions in this domain and strategically improve and enhance interactions to provide broader access while being open for future developments and use cases.

The thesis characterizes interactions in cultural heritage information systems and links them to access points of the digital material. Foci were aspects of collaboration and community building and their relationship with contextualizing digital cultural heritage material. Based on use cases and a grounded theory approach for data analysis, seven interrelated classes of interactions were developed that center around the origin of the digital objects, curational user activities and the support of community creation by setting incentives for purposeful contributions. This categorization of interactions was complemented by a second dimension that determines the level or degree of interactions in each class. It showed to which extent the interactions were implemented ranging from *Basic Functionality* to *Collaboration*. These levels were linked to the access modes *Search*, *Browse* and *Engage*. The more interaction classes strive for *Collaboration*, the more access points for the material are

created. This framework for interactions offers a holistic approach to understand interactions and their interplay with information access. The interrelatedness lets stakeholders in cultural heritage institutions understand that each decision in the information design influences how users access and interact with digital material. The framework does not only deliver a vocabulary to discuss interactions and their purpose in cultural heritage information systems, but also manifests a vision on how they should develop. It is set out to pin the present situation and give an outlook to potential future interactions.

To understand the prevailing interactions in cultural heritage information systems, a content analysis was conducted that mapped the interactions in 72 different cultural heritage information systems to the framework. Grouped into six clusters of different institutional or organization backgrounds, characteristics of cultural heritage information systems were determined revealing shortcomings and pinning down peculiarities. This helped to understand cultural heritage information systems better exposing common system design patterns that need to be challenged. For example, the focus on search as a primary entry point to collections is a major limitation for accessing cultural heritage material. The mimicking of web search engines can be considered rather harmful to the domain by barring it from other innovative access features. The focus on simple search box access to the material distorts the view for exploring alternatives. Memory institutions are slowly seeking new ways of experiencing and engaging with cultural heritage. Presently, only a handful of systems experiments with alternative access features that move away from textual retrieval and grouping of data based on metadata fields. The problem is that often, contextual information is not there. Slowly, memory institutions understand that they can leverage the object's characteristics for content-based retrieval (providing different access possibilities) and that users' perception of cultural heritage differs greatly from the experts. Search by color, for example, is a first step in this direction adapting to user needs for richer access options and consequently more engagement and involvement of user with digital cultural heritage material.

In the last step, six systems were evaluated in more depth mapping their interactions to the framework and comparing them with each other. The goal was to reveal weaknesses in the interaction strategy and how to improve it. Anchoring interactions in the framework leads to a holistic picture of the services and offerings of each of the analyzed systems. Concrete recommendations for the systems were derived. Based on this analysis, recommendations for the system design of the whole

domain were given focusing on delivering purposeful interactions that help users to engage with the material while benefiting institutions in fulfilling their missions.

With this dissertation, a first comprehensive analysis of interactions in the cultural heritage area was provided. It offers system designers, developers and other information professionals with a metric to evaluate their systems and derive meaningful recommendations for improving access and engagement.

8.1. Contribution

This thesis was set out to answer several research questions. The first one asked how user interactions can be characterized in cultural heritage information systems and how they can be related to information access to digital cultural material. The question is answered in chapter 5, which developed a framework for interactions in cultural heritage information systems. This framework gives a comprehensive overview on the interplay of access points and user interactions within an information system based on three interaction meta-classes, *Content*, *Curation* and *Support*. It is a holistic model that combines user interactions and their degree of implementation with common access points. The more complex and collaborative the interactions are, the more access points are created for the material benefitting successive users. For cultural institutions, it is highly relevant to understand how the implementation of certain interactions and curational activities influences the accessibility of their material.

The second research question illuminates whether cultural heritage information systems offer different interactions. The answer is given in chapter 6 which highlights the differences between the systems. These contrasts depend on several factors such as the historically evolved information organization systems and the institutions' progress in the digitization process. It was found that among the examined groups, interactions differ immensely and characteristic patterns can be found for each one of them.

The last question examined how the evaluation of user interactions can be leveraged for effective system design. In chapter 7, several results and recommendations were provided for each information system that was evaluated with the framework. These were then generalized for the whole domain referring to the development of an effective system design strategy. One main recommendation discusses the limits of search and how to overcome them. Users are another central point in the recommendations as they can help to improve metadata quality and contex-

tualize the content. To support user contributions even more, cultural institutions should strive for collaboration in the curational activities. This ensures the building of an active community where abuse and misuse cannot gain a foothold.

8.2. Future Work

This thesis presents a first step in understanding interactions in cultural heritage information systems and delivers a tool to evaluate existing systems and their interactions to derive recommendations to improve cultural heritage systems for future use. In subsequent work, this can be further expanded. The research can be further supported by user behavior studies that map users' behavior to the framework. One possibility here is to use log file studies to pin certain activities to interaction classes and relate them to access points. This could give a clearer picture of the interactions that are used and where there might be flaws in the system design. Interaction paths or click streams of users found in the log files could be also classified and mapped to the framework. The framework as used in this thesis looks at the existing interactions patterns but did not analyze to which degree they were engaging users. The gap between the offering and the use of these interactions is an interesting question to follow up upon. It would also be beneficial to involve stakeholders of memory institutions and to identify their intentions for implementing or abandoning interactions in given systems.

Additionally, the *Engage* access points could be researched in more depth. Which outcomes of interactions, such as tags for example, are translatable into access points? How does each of these access points influence information access and which ones have the biggest impact?

Research in this area can be pursued in two main directions. The first direction focuses on the system side of the problem and the second one examines the user-facing consequences of interactions in cultural heritage. On the system side, the main focus could be a closer examination of the different access points and their influence on accessing the material. This can be evaluated with information retrieval methods. What influences do user created access points have on retrieval performance? Some work in this direction was done with folksonomies and social tagging but there is no thorough study on consequences and implications of user contributed access points. Another question is how the users' contributions in general can be harnessed to improve access to digital material. These can be any traces the users leave during their path in the system reaching from queries to comments

and likes. Automatic solutions can be found to leverage this input and use it for improving the overall system.

On the user-facing side, it could be researched what the features and components of system design are that let user participate more in contributing high quality content. Usability and user behavior studies can be used to evaluate existing interactions with regard to the users' acceptance of certain features. Furthermore, more insights are needed on the user's perception of interaction features and their desired handling of digital cultural heritage material.

Overall, memory institutions and their users - potentially all members of a society - are both producers and consumers of cultural heritage. We shape our collective memory and together we need to find interactions with digital cultural heritage that make these activities meaningful and sustainable. This process has just begun. We cannot yet foresee how the digital medium is going to change how we interact and perceive cultural heritage. A first step is to broaden the access to the material and let every single person engage with it while supporting rich experiences. We, as stakeholders, have to guide this process that involves the change of roles for memory institutions and a shift in perceptions of our cultural material. This requires time and a deep understanding all components involved. The potential of this opportunity is beyond imagination now, but with every step we will shape the future of digital cultural heritage interactions.

References

Agosti, M. (2008). Information access using the guide of user requirements. In M. Agosti (Ed.), *Information access through search engines and digital libraries (The Information Retrieval Series, vol. 22)* (p. 1-12). Berlin / Heidelberg: Springer.

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A pattern language: Towns, buildings, construction*. New York, NY: Oxford University Press, Incorporated.

Al-Khalifa, H. S., & Davis, H. C. (2006). Harnessing the wisdom of crowds: How to semantically annotate web resources using folksonomies. In *IADIS web applications and research 2006 (WAR2006).* Available from `http://eprints.soton.ac.uk/id/eprint/263158`

Altman, B., & Nemmers, J. R. (2001). The usability of on-line archival resources: The polaris project finding aid. *Special Collections and Archives*, *64*(1), 121-131.

Amin, A., Ossenbruggen, J. v., Hardman, L., & Nispen, A. v. (2008). Understanding cultural heritage experts' information seeking needs. In G. Newton, M. Wright, & L. Cassel (Eds.), *Proceedings of the 8th ACM/IEEE-CS joint conference on digital libraries (JCDL 2008)* (p. 39-47). New York, NY: ACM.

Anderson, I. G. (2004). Are you being served? Historians and the search for primary sources. *Archivaria*, *58*, 81-129.

Anderson, S. R., & Allen, R. B. (2012). Malleable finding aids. In P. Zaphiris, G. Buchanan, E. Rasmussen, & F. Loizides (Eds.), *Theory and practice of digital libraries: Proceedings of the second international conference (Lecture Notes in Computer Science, vol. 7486)* (p. 402-407). Berlin / Heidelberg: Springer.

Anfinnsen, S., Ghinea, G., & Cesare, S. de. (2011). Web 2.0 and folksonomies in a library context. *International Journal of Information Management*, *31*(1), 63-70.

Ardissono, L., Kuflik, T., & Petrelli, D. (2012). Personalization in cultural heritage: The road travelled and the one ahead. *User Modeling and User-Adapted Interaction*, *22*(1-2), 73-99.

Arns, J. W. (2009). Libraries. In M. Bates & M. N. Maack (Eds.), *Encyclopedia of library and information sciences* (p. 3281-3286). Boca Raton, FL: CRC Press.

Baeza-Yates, R., Calderon-Benavides, L., & Gonzalez-Caro, C. (2006). The intention behind web queries. In F. Crestani, P. Ferragina, & M. Sanderson (Eds.), *String processing and information retrieval (Lecture Notes in Computer Science, vol. 4209)* (p. 98-109). Berlin / Heidelberg: Springer.

Bates, M. (1986). An exploratory paradigm for online information retrieval. In B. C. Brookes (Ed.), *Intelligent information systems for the information society:*

Proceedings of the sixth international research forum in information science (IRFIS 6) (p. 91-99). Amsterdam: North-Holland.

Bates, M. (1989). The design of browsing and berrypicking techniques for the online search interface. *Online Review*, *13*(5), 407-424.

Bates, M. (2002). The cascade of interactions in the digital library interface. *Information Processing and Mangement*, *38*(3), 381-400.

Bates, M. (2007a). Defining the information disciplines in encyclopedia development. *Information Research*, *12*(4). Available from http://informationr.net/ir/12-4/colis/colis29.html

Bates, M. (2007b). What is browsing - really? A model drawing from behavioural science research. *Information Research*, *12*(4, paper 330). Available from http://informationr.net/ir/12-4/paper330.html

Bates, M., Wilde, D. N., & Siegfried, S. (1993). An analysis of search terminology used by humanities scholars: The Getty online searching project report number 1. *The Library Quarterly*, *63*(1), 1-39.

Beagrie, N. (2005). Plenty of room at the bottom? Personal digital libraries and collections. *D-Lib Magazine*, *11*(6). Available from http://www.dlib.org/dlib/june05/beagrie/06beagrie.html

Bearman, D. (2008). Representing museum knowledge. In P. F. Marty & K. B. Jones (Eds.), *Museum informatics: People, information, and technology in museums* (p. 35-57). New York, NY: Routledge.

Bearman, D., & Trant, J. (2002). Issues in structuring knowledge and services for universal access to online science and culture. Available from http://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/symposia/ns120-lectures/bearman.pdf

Bernhoff, J., & Anderson, J. (2010). *Social technographics defined* (Presentation). Forrester Research. Available from http://www.slideshare.net/jbernoff/social-technographics-defined-2010

Bertacchini, F., Enrico; Morando. (2013). The future of museums in the digital age: New models for access to and use of digital collections. *International Journal of Arts Management*, *15*(2), 60-72.

Europeana Foundation. (2013). *Europeana data model primer* (Tech. Rep.). Europeana Foundation. Available from http://pro.europeana.eu/documents/900548/770bdb58-c60e-4beb-a687-874639312ba5

Booth, B. (1998). Understanding the information needs of visitors to museums. *Museum Management and Curatorship*, *17*(2), 139-157.

Borchers, J. O., & Thomas, J. C. (2001). Patterns: What's in it for HCI? In M. Tremaine (Ed.), *Extended abstracts of the CHI 2001 conference on human factors in computing systems.* New York, NY: ACM.

Broder, A. (2002). A taxonomy of web search. *SIGIR Forum*, *36*(2), 3-10.

Buckland, M. (1991). *Information and information systems*. New York, NY: Greenwood Press.

Buraimo, B., Jones, H., & Millward, P. (2011). *Participation and engagement in cultural activities: Analysis of the taking part survey* (Report). Department for Culture, Media and Sport. Available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/137982/tp-participation-engagement-culture-activities-report.pdf

Burcaw, G. (1997). *Introduction to museum work* (3rd ed.). Walnut Creek, CA: Altamira Press.

Cahill, K. (2009). *User-generated content and its impact on web-based library services*. Oxford, UK: Chandos Publishing.

Cairns, S. (2011). Tag! You're it! What value do folksonomies bring to the online museum collection? In J. Trant & D. Bearman (Eds.), *Museums and the web 2011: Proceedings.* Toronto: Archives & Museum Informatics. Available from http://www.museumsandtheweb.com/mw2011/papers/tag_youre_it_what_value_do_folksonomies_bring_.html

Calhoun, K. (2006). *The changing nature of the catalog and its integration with other discovery tools: prepared for the library of congress* (Tech. Rep.). Ithaca, NY: Cornell University Library.

Chad, K., & Miller, P. (2005). *Do libraries matter? The rise of Library 2.0* (White Paper). Talis. Available from http://www.capita-libraries.co.uk/downloads/white_papers/DoLibrariesMatter.pdf

Chae, G., & Kim, J. (2011). Can social tagging be a tool to reduce the semantic gap between curators and audiences? Making a semantic structure of tags by implementing the facetted tagging system for online art museums. In J. Trant & D. Bearman (Eds.), *Museums and the web 2011: Proceedings.* Toronto: Archives & Museum Informatics. Available from http://www.museumsandtheweb.com/mw2011/papers/can_social_tagging_be_a_tool_to_reduce_the_sem

Chang, S.-J., & Rice, R. E. (1993). Browsing: A multidimensional framework. *Annual Review of Information Science and Technology*, *28*, 231–276.

Chapman, J. C. (2010). Observing users: An empirical analysis of user interaction

with online finding aids. *Journal of Archival Organization*, *8*(1), 4-30.

Chen, S. Y., Teng, Y. Y., & Ke, H. R. (2008). Social tagging in digital archives. In G. Buchanan, M. Masoodian, & S. J. Cunningham (Eds.), *Digital libraries: Universal and ubiquitous access to information: Proceedings of the 11th international conference on asian digital libraries, ICADL 2008 (Lecture Notes in Computer Science, vol. 5362)* (p. 414-415). Berlin / Heidelberg: Springer.

Conrady, J. (2012). *A crowdsourcing project with a 'predefined crowd'. Involving secondary school students in the contextualisation of digital cultural heritage objects*. Master thesis in book and digital media studies, Leiden University.

Cool, C., & Belkin, N. J. (2002). A classification of interactions with information. In H. Bruce, R. Fidel, P. Ingwersen, & P. Vakkari (Eds.), *Emerging frameworks and methods: Proceedings of the fourth international conference on conceptions of library and information science (COLIS4)* (p. 1-15). Greenwood Village, Colorado: Libraries Unlimited.

Cooper, A., Reimann, R., & Cronin, D. (2007). *About Face 3: The essentials of interaction design* (3rd ed.). Indianapolis, IN: Wiley.

Cooper, J. (2006). Beyond the on-line museum: Participatory virtual exhibitions. In J. Trant & D. Bearman (Eds.), *Museums and the web 2006: Proceedings.* Toronto: Archives & Museum Informatics. Available from `http://www.museumsandtheweb.com/mw2006/papers/cooper/cooper.html`

Cove, J. F., & Walsh, B. C. (1988). Online text retrieval via browsing. *Information Processing & Management*, *24*(1), 31-37.

Cox, R. J. (2008). Revisiting the archival finding aid. *Journal of Archival Organization*, *5*(4), 5-32.

Creswell, J. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage Publications Ltd.

Cruikshank, K., Daniels, C., Meissner, D., Nelson, N. L., & Shelstad, M. (2005). How do we show you what we've got? Access to archival collections in the digital age. *Journal of the Association for History and Computing*, *8*(2). Available from `http://hdl.handle.net/2027/spo.3310410.0008.203`

Cunningham, A. (2009). Archives. In M. Bates & M. N. Maack (Eds.), *Encyclopedia of library and information sciences* (p. 192-207). Boca Raton, FL: CRC Press.

Daines, J. G., & Nimer, C. L. (2011). Re-imagining archival display: Creating user-friendly finding aids. *Journal of Archival Organization*, *9*(1), 4-31.

Dalbello, M. (2009). Digital cultural heritage: Concepts, projects, and emerging constructions of heritage. In E. Liddy & M. Dalbello (Eds.), *Pro-*

ceedings of the libraries in the digital age (LIDA) conference. Available from http://arizona.openrepository.com/arizona/bitstream/10150/106136/1/Dalbello_LIDA2009_text_2_dlist.pdf

Davis, A. (2004). Co-authoring identity: Digital storytelling in an urban middle school. *THEN: Journal*, *1*(1). Available from http://thenjournal.org/feature/61/

Dillenburg, E. (2011). What, if anything, is a museum? *Exhibitionist*, *Spring 2011*, 8-13.

Dobreva, M., McCulloch, E., Birrell, D., Feliciati, P., Ruthven, I., Sykes, J., et al. (2010). *User and functional testing: Final report.* (Deliverable). Europeana v1.0 Project. Available from http://pro.europeana.eu/c/document_library/get_file?uuid=1c25ae28-9457-4b0f-be62-654a7cf6c5b7&groupId=10602

Dobreva, M., O'Dwyer, A., & Feliciati, P. (2011). Introduction: user studies for digital library development. In M. Dobreva, A. O'Dwyer, & P. Feliciati (Eds.), *User studies in digital library development. facet, london.* London: Facet.

Dörk, M., Carpendale, S., & Williamson, C. (2011). The information flaneur: A fresh look at information seeking. In *CHI '11 proceedings of the SIGCHI conference on human factors in computing systems* (p. 1215-1224). New York, NY: ACM.

Dowler, L. (1988). The role of use in defining archival practice and principles: A research agenda for the availability and use of records. *American Archivist*, *51*, 74-86.

Duff, W. M., & Johnson, C. A. (2002). Accidentally found on purpose: Information-seeking behavior of historians in archives. *The Library Quarterly*, *72*(4), 472-496.

Duff, W. M., & Stoyanova, P. (1998). Transforming the crazy quilt: Archival displays from a user's point of view. *Archivaria*(45). Available from http://journals.sfu.ca/archivar/index.php/archivaria/article/view/12224/13243

Dupont, C. (2007). Libraries, archives, and museums in the twenty-first century: Intersecting missions, converging futures? *RBM: A Journal of Rare Books, Manuscripts, and Cultural Heritage*, *8*(1), 13-19.

Durbin, G. (n.d.). *User-generated content on museum websites* (Online article). Museum ID - Ideas. Available from http://www.museum-id.com/idea-detail.asp?id=352

Eisenhardt, K. M. (1989). Building theories from case study research. *The Academy*

of Management Review, *14*(4), 532-550.

Eleta, I., & Golbeck, J. (2012). A study of multilingual social tagging of art images: Cultural bridges and diversity. In S. E. Poltrock, C. Simone, J. Grudin, & J. R. Gloria Mark (Eds.), *Proceedings of the ACM 2012 conference on computer supported cooperative work* (p. 695-704). New York, NY: ACM.

Ellenbogen, K., Falk, J., & Goldman, K. H. (2008). Understanding the motivations of museum audiences. In P. Marty & K. B. Jones (Eds.), *Museum informatics: People, information and technology* (p. 187-194). New York, NY: Routledge.

Ellis, M., & Kelly, B. (2007). Web 2.0: How to stop thinking and start doing: Addressing organisational barriers. In J. Trant & D. Bearman (Eds.), *Museums and the web 2011: Proceedings.* Toronto: Archives & Museum Informatics. Available from `http://www.archimuse.com/mw2007/papers/ellis/ellis.html`

Fantoni, S. F. (2006). *GettyGuide Bookmarks: do they really work?* (Report). The J. Paul Getty Museum. Available from `http://www.getty.edu/museum/research/metrics_evaluations/downloads/gettyguide_bookmarks.pdf`

Fantoni, S. F., & Bowen, J. (2007). Bookmarking in museums: Extending the museum experience beyond the visit? In J. Trant & D. Bearman (Eds.), *Museums and the web 2007: Proceedings.* Toronto: Archives & Museum Informatics. Available from `http://www.archimuse.com/mw2007/papers/filippini-fantoni/filippini-fantoni.html`

Fantoni, S. F., Stein, R., & Bowman, G. (2012). Exploring the relationship between visitor motivation and engagement in online museum audiences. In J. Trant & D. Bearman (Eds.), *Museums and the web 2012: Proceedings.* Toronto: Archives & Museum Informatic. Available from `http://www.museumsandtheweb.com/mw2012/papers/exploring_the_relationship_between_visitor_mot`

Farber, A., & Radensky, P. (2008). Living museum®: Supporting the creation of quality user-generated content. In J. Trant & D. Bearman (Eds.), *Museums and the web 2008: Proceedings.* Toronto: Archives & Museum Informatics. Available from `http://www.museumsandtheweb.com/mw2008/papers/farber/farber.html`

Farkas, M. (2007). *Social software in libraries: Building collaboration, communication, and community online*. Medford, New Jersey: Information Today.

Fidel, R. (1984). The case study method: A case study. *Library and Information*

Science Research, *6*, 273-288.

Fisher, K. E., & Julien, H. (2009). Information behavior. *Annual Review of Information Science and Technology*, *43*(1), 1-73.

Forte, A., & Lampe, C. (2013). Defining, understanding, and supporting open collaboration: Lessons from the literature. *American Behavioral Scientist*, *57*(5), 535-547.

Foster, A., & Ford, N. (2003). Serendipity and information seeking: An empirical study. *Journal of Documentation*, *59*(3), 321-340.

Freedman, G. (2000). The changing nature of museums. *The Museum Journal*, *43*(4), 295–306.

Friedrich, G. W., & Turock, B. J. (2009). Access in a digital age. In M. Bates & M. N. Maack (Eds.), *Encyclopedia of library and information sciences* (3rd ed., p. 23-33). Boca Raton, FL: CRC Press.

Frieseke, M., Gäde, M., Petras, V., & Stiller, J. (2011). *Interaction patterns in cultural heritage information systems* (Unpublished report). Project Promise - Participative Research labOratory for Multimedia and Multilingual Information Systems Evaluation.

Frusciano, T. J. (2011). Online finding aids, catalog records, and access-revisited. *Journal of Archival Organization*, *9*(1), 1-3.

Garrett, J. J. (2011). *The elements of user experience: User-centered design for the web and beyond* (2nd ed.). Berkeley, CA: New Riders.

Gibbons, S. (2003). Building upon the mylibrary concept to better meet the information needs of college students. *D-Lib Magazine*, *9*(3). Available from `http://www.dlib.org/dlib/march03/gibbons/03gibbons.html`

Given, L. M., & McTavish, L. (2010). What's old is new again: The reconvergence of libraries, archives, and museums in the digital age. *Library Quarterly*, *80*(1), 7-32.

Glaser, B. G., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine Publishing Co.

Golder, S. A., & Huberman, B. A. (2005). The structure of collaborative tagging systems. *Journal of Information Science*, *32*(2), 198-208.

Goldman, K. H., & Schaller, D. (2004). Exploring motivational factors and visitor satisfaction in on-line museum visits. In J. Trant & D. Bearman (Eds.), *Museums and the web 2004: Proceedings.* Toronto: Archives & Museum Informatic. Available from `http://www.archimuse.com/mw2004/papers/haleyGoldman/haleyGoldman.html`

Goodale, P., Hall, M., Fernie, K., & Archer, P. (2011). *D 1.1 User requirements analysis* (Deliverable). Paths Project. Available from http://www.paths-project.eu/eng/content/download/456/2288/file/D1.1%20User%20Requirements%20Analysis%20v1.0.pdf

Griffis, P., & Ford, C. (2009). Enhancing OPAC records for discovery. *Information Technology and Libraries*, *28*(4), 191-193.

Hagel, v. F., & Sieglerschmidt, J. (2002). Documentation in museums, libraries and archives. *Information - Wissenschaft & Praxis*, *53*(6), 347-354.

Hazan, S. (2006). A crisis of authority: Old lamps for new. In F. Cameron & S. Kenderdine (Eds.), *Theorizing digital cultural heritage. a crititcal discourse* (p. 133-148). Cambridge, MA: MIT Press.

Hearst, M. A. (2009). *Search user interfaces*. Cambridge, MA: Cambridge University Press.

Hjerppe, R. (1986). Project HYPERCATalog: Visions and preliminary conceptions of an extended and enhanced catalog. In B. C. Brookes (Ed.), *Intelligent information systems for the information society: Proceedings of the sixth international research forum in information science (IRFIS 6)* (p. 211-232). Amsterdam / New York, NY: North-Holland.

Hjørland, B. (2000). Documents, memory institutions and information science. *Journal of Documentation*, *56*(1), 27-41.

Holley, R. (2010a). Crowdsourcing: How and why should libraries do it? *D-Lib Magazine*, *16*(3/4). Available from http://www.dlib.org/dlib/march10/holley/03holley.html

Holley, R. (2010b). Trove: Innovation in access to information in australia. *Ariadne*, *64*. Available from http://www.ariadne.ac.uk/issue64/holley/

Holmberg, K., Huvila, I., Kronqvist-Berg, M., & Widén-Wulff, G. (2009). What is library 2.0? *Journal of Documentation*, *65*(4), 668 - 681.

Howe, J. (2006a). *Crowdsourcing: A definition.* Available from http://crowdsourcing.typepad.com/cs/2006/06/crowdsourcing_a.html

Howe, J. (2006b). The rise of crowdsourcing. *Wired magazine*(14). Available from http://www.wired.com/wired/archive/14.06/crowds.html

Hughes-Morgan, K., & Wilson, M. L. (2012). Information vs interaction - examining their individual effects on searchers. In J. Kamps, W. Kraaij, & N. Fuhr (Eds.), *Proceedings of the 4th information interaction in context symposium IIix'12* (p. 72-81). New York, NY: ACM.

Hurlburt, G. F., & Voas, J. (2011). Storytelling: From cave art to digital media. *IT Professional*, *13*(5), 4 - 7.

Hutchinson, H. B., Druin, A., & Bederson, B. B. (2007). Supporting elementary-age children's searching and browsing: Design and evaluation using the international children's digital library. *Journal of the American Society for Information Science and Technology*, *58*(11), 1618-1630.

Hutchinson, H. B., Rose, A., Bederson, B. B., Weeks, A. C., & Druin, A. (2005). The international children's digital library: A case study in designing for a multilingual, multicultural, multigenerational audience. *Information Technology and Libraries*, *24*(1), 4-12.

Huvila, I. (2008). Participatory archive: Towards decentralised curation, radical user orientation, and broader contextualisation of records management. *Archival Science*, *8*(1), 15-36.

International Council of Museums. (2007). *Museum definition.* Available from `http://icom.museum/the-vision/museum-definition/`

International Council on Archives. (2009). *About records, archives and the profession.* Available from `http://www.ica.org/125/about-records-archives-and-the-profession/discover-archives-and-our-profession`

Isaac, A. (2013). *What is Europeana doing with semantic web and linked open data?* (Blog post). Lodlam - Linked Open Data in Libraries, Archives and Museums. Available from `http://lodlam.net/2013/06/18/what-is-europeana-doing-with-sw-and-lod/`

Jansen, B. J., Booth, D. L., & Spink, A. (2007). Determining the user intent of web search engine queries. In P. F. Patel-Schneider & P. Shenoy (Eds.), *WWW '07 proceedings of the 16th international conference on world wide web* (p. 1149-1150). New York, NY: ACM.

Johnson, F. C., & Craven, J. (2010). Beyond usability: The study of functionality of the 2.0 online catalogue (OPAC). *New Review of Academic Librarianship*, *16*(2), 228-250.

Johnsson, E. (2006). *Telling tales: A guide to developing effective storytelling programmes for museums* (Report). London Museums Hub. Available from `http://showmuz.files.wordpress.com/2009/09/storytelling-guide.pdf`

Jones, K. B. (2007). The transformation of the digital museum. In P. Marty & K. B. Jones (Eds.), *Museum informatics: People, information, and technology in*

museums. (p. 9-25). New York, NY: Routledge.

Jones, S. (2002). *The internet goes to college: How students are living in the future with today's technology* (Report). Pew Internet & American Life Project. Available from http://www.pewinternet.org/~/media/Files/Reports/2002/PIP_College_Report.pdf.pdf

Jones, S., Cunningham, S. J., & McNab, R. (1998). An analysis of usage of a digital library. In C. Nikolaou & C. Stephanidis (Eds.), *European conference on digital libraries '98 (Lecture Notes in Computer Science, vol. 151)* (p. 261-277). Berlin / Heidelberg: Springer.

Kaplan, B., & Duchon, D. (1988). Combining qualitative and quantitative methods in information systems research: A case study. *MIS Quarterly*, *12*(4), 571-586.

Karlgren, J. (2011). The use case perspective for single query information access. In *SIGIR 2011 workshop on "entertain me": Supporting complex search tasks.* New York, NY: ACM. Available from http://staff.science.uva.nl/~kamps/entertainme/papers/entertainme11-1.pdf

Kellar, M., Watters, C., & Shepherd, M. A. (2006). Goal-based classification of web information tasks. In A. Grove (Ed.), *69th annual meeting of the american society for information science and technology (ASIST)* (p. 101-112).

Kelly, D. (2009). *Methods for evaluating interactive information retrieval systems with users (Foundations and Trends in Information Retrieval, vol. 3)*. Hanover, MA: Now Publishers.

Kelly, D., & Belkin, N. J. (2002). A user modeling system for personalized interaction and tailored retrieval in interactive IR. *Proceedings of the American Society for Information Science and Technology*, *39*(1), 316-325.

Kim, J. (2004). EAD encoding and display: A content analysis. *Journal of Archival Organization*, *2*(3), 41-55.

Klavans, J., Stein, R., Chun, S., & Guerra, R. D. (2011). Computational linguistics in museums: Applications for cultural datasets. In J. Trant & D. Bearman (Eds.), *Museums and the web 2011: Proceedings.* Toronto: Archives & Museum Informatics. Available from http://www.museumsandtheweb.com/mw2011/papers/computational_linguistics_in_museums_applicati.html

Kohn, R. H. (1995). History and the culture wars: The case of the smithsonian institution's enola gay exhibition. *The Journal of American History*, *82*(3), 1036-1063.

Komlodi, A., Ho, W., Preece, J., Druin, A., Golub, E., Alburo, J., et al. (2007). Eval-

uating a cross-cultural children's online book community: Lessons learned for sociability, usability, and cultural exchange. *Interacting with Computers*, *19*, 494-511.

Koolen, M., Arampatzis, A., Kamps, J., Keijzer, V. d., & Nussbaum, N. (2007). Unified access to heterogeneous data in cultural heritage. In D. Evans, S. Furui, & C. Soulé-Dupuy (Eds.), *Computer-assisted information retrieval (recherche d'information et ses applications) - RIAO 2007, 8th international conference* (p. 108-122).

Krause, M., & Yakel, E. (2007). Interaction in virtual archives: The polar bear expedition digital collections next generation finding aid. *American Archivist*, *70*(2), 282-314.

Kuhlthau, C. (1991). Inside the search process: Information seeking from the user's perspective. *Journal of the American Society for Information Science*, *42*(5), 361–371.

Kumar, S. (2013). From clay tablet to web: Journey of library catalogue. *DESIDOC Journal of Library & Information Technology*, *33*(1), 45-54.

Kunert, T. (2009). *User-centered interaction design patterns for interactive digital television applications (Human-Computer Interaction Series)*. Berlin / Heidelberg: Springer.

Lancaster County Planning Commission. (2007). *Telling our stories. An interpretation manual for heritage partners* (Report). Lancaster County Planning Commission.

Lazar, J., Feng, J., & Hochheiser, H. (2010). *Research methods in human-computer interaction*. Chichester, UK: John Wiley and Sons.

Lee, C. A. (2011). A framework for contextual information in digital collections. *Journal of Documentation*, *67*(1), 95-143.

Lee, U., Liu, Z., & Cho, J. (2005). Automatic identification of user goals in web search. In A. Ellis & T. Hagino (Eds.), *WWW '05 proceedings of the 14th international conference on world wide web* (p. 391-400). New York, NY: ACM.

Lee, Y.-W., Chen, F.-C., & Jiang, H.-M. (2006). Lurking as participation: A community perspective on lurkers' identity and negotiability. In S. Barab, K. Hay, & D. Hickey (Eds.), *ICLS '06 proceedings of the 7th international conference on learning sciences* (p. 404-410). Bloomington: International Society of the Learning Sciences.

Liew, C. L. (2005). Online cultural heritage exhibitions: A survey of information retrieval features. *Program: Electronic library and information systems*, *39*(1), 4-24.

Light, M., & Hyry, T. (2002). Colophons and annotations: New directions for the finding aid. *American Archivist*, *65*(2), 216-230.

Lynch, C. A. (2009). Special collections at the cusp of the digital age: A credo. *Research Library Issues*(267), 3-9.

Marchionini, G. (2004). From information retrieval to information interaction. In S. McDonald & J. Tait (Eds.), *Advances in information retrieval: Proceedings of the 26th european conference on ir research, ECIR 2004 (Lecture Notes in Computer Science, vol. 2997)* (p. 1-11). Berlin / Heidelberg: Springer.

Marchionini, G. (2006). Exploratory search: From finding to understanding. *Communications of the ACM*, *49*(4), 41-46.

Marchionini, G. (2008). Human-information interaction research and development. *Library and Information Science Research*, *30*(3), 165-174.

Marlow, C., Naaman, M., Boyd, D., & Davis, M. (2006). Ht06, tagging paper, taxonomy, flickr, academic article, to read. In U. K. Wiil, P. J. Nürnberg, & J. Rubart (Eds.), *HYPERTEXT '06: Proceedings of the seventeenth conference on hypertext and hypermedia* (p. 31-40). New York, NY: ACM.

Marty, P. F. (2007). Museum websites and museum visitors: Before and after the museum visit. *Museum Management and Curatorship*, *22*(4), 337-360.

Marty, P. F. (2008a). Changing needs and expectations. In P. F. Marty & K. B. Jones (Eds.), *Museum informatics: People, information and technology* (p. 181-185). New York, NY: Routledge.

Marty, P. F. (2008b). Information representation. In P. F. Marty & K. B. Jones (Eds.), *Museum informatics: People, information and technology* (p. 29-34). New York, NY: Routledge.

Marty, P. F. (2008c). Museum websites and museum visitors: Digital museum resources and their use. *Museum Management and Curatorship*, *23*(1), 81-99.

Marty, P. F. (2010). An introduction to digital convergence: Libraries, archives, and museums in the information age. *Library Quarterly*, *80*(1), 1-5.

Marty, P. F. (2011). My lost museum: User expectations and motivations for creating personal digital collections on museum websites. *Library & Information Science Research*, *33*(3), 211-219.

McCarthy, G. (2007). Finding a future for digital cultural heritage resources using contextual information frameworks. In F. Cameron & S. Kenderdine (Eds.), *Theorizing digital cultural heritage. A critical discourse* (p. 245-260). Cambridge, MA: MIT Press.

McCrary, Q. (2011). The political nature of digital cultural heritage. *Liber Quarterly:*

The Journal of European Research Libraries, *20*(3/4), 357-368.

Mi, J., & Weng, C. (2008). Revitalizing the library opac: Interface, searching, and display challenges. *Information Technology and Libraries*, *27*(1), 5-22.

Millen, D. R., & Feinberg, J. (2006). Using social tagging to improve social navigation. In P. Brusilovsky, J. Dron, & J. Kurhila (Eds.), *Workshop on the social navigation and community based adaptation technologies.* Available from http://www.sis.pitt.edu/~paws/SNC_BAT06/crc/millen.pdf

Morville, P., & Callender, J. (2010). *Search patterns*. Sebastopol, CA: O'Reilly Media.

Murray, J. H. (2011). *Inventing the medium: Principles of interaction design as a cultural practice*. Cambridge, MA: MIT Press.

Neuendorf, K. A. (2002). *The content analysis guidebook*. Thousand Oaks, CA: Sage Publications, Inc.

Newell, J. (2012). Old objects, new media: Historical collections, digitization and affect. *Journal of Material Culture*, *17*(3), 287-306.

Nielsen, J. (2001). *First rule of usability? Don't listen to users* (Online article). Available from http://www.nngroup.com/articles/first-rule-of-usability-dont-listen-to-users/

Nielsen, J. (2006). *Participation inequality: Encouraging more users to contribute* (Online article). Available from http://www.nngroup.com/articles/participation-inequality/

Nielsen, J., & Molich, R. (1990). Heuristic evaluation of user interfaces. In J. C. Chew & J. Whiteside (Eds.), *CHI '90 proceedings of the SIGCHI conference on human factors in computing systems* (p. 249-256). New York, NY: ACM.

Nimer, C., & Daines, J. G. (2008). What do you mean it doesn't make sense? Redesigning finding aids from the user's perspective. *Journal of Archival Organization*, *6*(4), 216-232.

Noerr, P. L., & Bivins Noerr, K. T. (1985). Browse and navigate: An advance in database access methods. *Information Processing & Management*, *21*(3), 205-213.

Norman, D. (1988). *The psychology of everyday things*. New York, NY: Basic Books.

Novia, J. (2012). Library, archival and museum (LAM) collaboration: Driving forces and recent trends. *Endnotes: The Journal of the New Members Round Table*, *3*(1). Available from http://www.ala.org/nmrt/sites/ala.org.nmrt/files/content/oversightgroups/comm/schres/endnotesvol3no1/2lamcollaboration.pdf

Olensky, M., Stiller, J., & Dröge, E. (2012). Poisonous india or the importance of a

semantic and multilingual enrichment strategy. In J. M. Dodero, M. Palomo-Duarte, & P. Karampiperis (Eds.), *Proceedings of the 6th metadata and semantics research conference, MTSR 2012 (Communications in Computer and Information Science, vol. 343)* (p. 252-263). Berlin / Heidelberg: Springer.

Olson, H. A. (2001). The power to name: Representation in library catalogs. *Signs*, *26*(3), 639-668.

Oomen, J., & Aroyo, L. (2011). Crowdsourcing in the cultural heritage domain: Opportunities and challenges. In J. Kjeldskov & J. Paay (Eds.), *C&T '11 proceedings of the 5th international conference on communities and technologies* (p. 138-149). New York, NY: ACM.

O'Reilly, T. (2005). *What is web 2.0? Design patterns and business models for the next generation of software* (Online Article). Available from `http://oreilly.com/web2/archive/what-is-web-20.html`

Organisciak, P. (2010). *Why bother? Examining the motivations of users in large-scale crowd-powered online initiatives.* Master thesis in humanities computing, University of Alberta.

Palmer, J. (2009). Archives 2.0: If we build it, will they come? *Ariadne*(60). Available from `http://www.ariadne.ac.uk/issue60/palmer`

Pandit, M. R. (1996). The creation of theory: A recent application of the grounded theory method. *The Qualitative Report*, *2*(4). Available from `http://www.nova.edu/ssss/QR/QR2-4/pandit.html`

Patton, M. (2002). *Qualitative research and evaluation methods*. Beverly Hills: Sage Publications.

Peacock, J., D.; Brownbill. (2007). Audiences, visitors, users: Reconceptualising users of museum on-line content and services. In J. Trant & D. Bearman (Eds.), *Museums and the web 2007: Proceedings.* Toronto: Archives & Museum Informatics. Available from `http://www.museumsandtheweb.com/mw2007/papers/peacock/peacock.html`

Peters, C., & Sheridan, P. (2001). Multilingual information access. In M. Agosti, F. Crestani, & G. Pasi (Eds.), *Lectures on information retrieval: Third european summer-school, ESSIR 2000, revised lectures* (p. 51-80).

Peters, I. (2009). *Folksonomies: Indexing and retrieval in web 2.0*. Berlin: de Gruyter.

Petras, V., Stiller, J., & Gäde, M. (2013). Building for success (?) - Evaluating digital libraries in the cultural heritage domain. In C. Cool & K. B. Ng (Eds.), *Recent developments in the design, construction, and evaluation of digital libraries: Case studies* (p. 141-163). Hershey, PA: IGI Global.

Petrelli, D., Beaulieu, M., Sanderson, M., Demetriou, G., Herring, P., & Hansen, P. (2004). Observing users, designing clarity: A case study on the user-centered design of a cross-language information retrieval system. *Journal of the American Society for Information Science and Technology*, *55*(10), 923-934.

Petrelli, D., Levin, S., Beaulieu, M., & Sanderson, M. (2006). Which user interaction for cross-language information retrieval? Design issues and reflections. *Journal of the American Society for Information Science and Technology*, *57*(5), 709-722.

Pettigrew, K. E., Fidel, R., & Bruce, H. (2001). Conceptual frameworks in information behavior. *Annual Review of Information Science and Technology*, *35*, 43-78.

Pickard, A. J. (2007). *Research methods in information*. London: Facet.

Pike, W. A., Stasko, J., Chang, R., & O'Connell, T. A. (2009). The science of interaction. *Information Visualization*, *8*(4), 263-274.

Pitti, D. V. (1999). Encoded archival description: An introduction and overview. *D-Lib Magazine*, *5*(11). Available from `http://www.dlib.org/dlib/november99/11pitti.html`

Porter, B. (n.d.). *About digital storytelling.* Available from `http://digitales.us/about/digital-storytelling`

Preece, J., & Shneiderman, B. (2009). The reader-to-leader framework: Motivating technology-mediated social participation. *AIS Transactions on Human-Computer Interaction*, *1*(1), 13-32.

Presner, T. (2009). *The digital humanities manifesto 2.0.* UCLA Mellon Seminar in Digital Humanities. Available from `http://www.humanitiesblast.com/manifesto/Manifesto_V2.pdf`

Proctor, N. (2010). Digital: Museum as platform, curator as champion, in the age of social media. *Curator: The Museum Journal*, *53*(1), 35-43.

Prom, C. (2004). User interactions with electronic finding aids in a controlled setting. *American Archivist*, *67*(2), 234-268.

Pruulmann-Vengerfeldt, P., & Aljas, A. (2009). Digital cultural heritage - challenging museums, archives and users. *Journal of Ethnology and Folkloristics*, *3*(1), 109-127.

Purday, J. (2011). Europeana: From prototype to production. *Uncommon culture*, *3*(5/6). Available from `http://www.firstmonday.org/ojs/index.php/UC/article/view/3940/3141`

Rice, R. E., Mccreadie, M., & Chang, S. J. L. (2001). *Accessing and browsing information and communication*. Cambridge, MA: MIT Press.

Robin, B. R. (2008). Digital storytelling: A powerful technology tool for the 21st

century classroom. *Theory Into Practice*, *47*(3), 220-228.

Rogers, Y., Sharp, H., & Preece, J. (2007). *Interaction design: Beyond human-computer interaction* (2nd ed.). Chichester, UK: John Wiley & Sons.

Rose, D. E., & Levinson, D. (2004). Understanding user goals in web search. In S. I. Feldman, M. Uretsky, M. Najork, & C. E. Wills (Eds.), *Proceedings of the 13th international conference on world wide web WWW13* (p. 13-19). New York, NY: ACM.

Ruecker, S., Radzikowska, M., & Sinclair, S. (2012). *Visual interface design for digital cultural heritage: A guide to rich-prospect browsing*. Burlington, VT: Ashgate Publishing.

Russell, R., & Winkworth, K. (2009). *Significance 2.0 a guide to assessing the significance of collections* (Industry Report). Collections Council of Australia. Available from `http://arts.gov.au/sites/default/files/resources-publications/significance-2.0/pdfs/significance-2.0.pdf`

Saffer, D. (2009). *Designing for interaction: Creating smart applications and clever devices* (2nd ed.). Berkeley, CA: New Riders Publishing.

Sarraf, S. (1999). A survey of museums on the web: Who uses museum websites? *Curator: The Museum Journal*, *42*(3), 231-243.

Simon, N. (2010). *The participatory museum*. Santa Cruz, CA: Museum 2.0.

Skov, M., & Ingwersen, P. (2008). Exploring information seeking behaviour in a digital museum context. In P. Borlund et al. (Eds.), *Proceedings of the second international symposium on information interaction in context.* (p. 110-115). New York, NY: ACM.

Smith-Yoshimura, K., & Holley, R. (2012). *Social metadata for libraries, archives, and museums. Part 3: Recommendations and readings* (Report). San Mateo, CA: OCLC Research. Available from `http://www.oclc.org/content/dam/research/publications/library/2012/2012-01.pdf`

Smith-Yoshimura, K., & Shein, C. (2011). *Social metadata for libraries, archives and museums. Part 1: Site reviews* (Report). San Mateo, CA: OCLC Research. Available from `http://www.oclc.org/content/dam/research/publications/library/2011/2011-02.pdf`

Souza, C. S. de, Laffon, R. F., & Leitao, C. F. (2008). Communicability in multicultural contexts: A study with the international children's digital library. In P. Forbrig, F. Paternò, & A. M. Pejtersen (Eds.), *Human-computer interaction symposium (International Federation for Information Processing, vol. 272)* (p. 129-

142). Berlin / Heidelberg: Springer.

Spink, A., Jansen, B. J., Wolfram, D., & Saracevic, T. (2002). From e-sex to e-commerce: Web search changes. *IEEE Computer*, *35*(3), 107–111.

Spiteri, L. (2006). The use of folksonomies in public library catalogues. *The Serials Librarian*, *51*(2), 75-89.

Spock, D. (2009). Museum authority up for grabs. The latest thing, or following a long trend line? *Exhibitionist*, *Fall*, 6-10.

Springer, J., Kajder, S., & Brazas, J. B. (2004). Digital storytelling at the national gallery of art. In J. Trant & D. Bearman (Eds.), *Museums and the web 2004: Proceedings.* Toronto: Archives & Museum Informatics. Available from `http://www.archimuse.com/mw2004/papers/springer/springer.html`

Srinivasan, R., Boast, R., Becvar, K. M., & Furner, J. (2009). Blobgects: Digital museum catalogs and diverse user communities. *Journal of the American Society for Information Science and Technology*, *60*(4), 666-678.

Srinivasan, R., Boast, R., Furner, J., & Becvar, K. M. (2009). Digital museums and diverse cultural knowledges: Moving past the traditional catalog. *The Information Society*, *25*(4), 265-278.

Stiller, J. (2006). *Auf dem Wege zur digitalen Bibliothek: Digitalisierungsstrategien und ihre Konsequenzen*. Magister thesis in library and information science, Humboldt-Universität zu Berlin.

Stiller, J. (2012). A framework for classifying interactions in cultural heritage information systems. *International Journal of Heritage in the Digital Era: Proceedings of EUROMED 2012: Progress in Cultural Heritage Preservation*, *1*(Supplement 1), 141-146.

Stiller, J., Gäde, M., & Petras, V. (2010). Ambiguity of queries and the challenges for query language detection. In M. Braschler, D. Harman, & E. Pianta (Eds.), *CLEF 2010 labs and workshops notebook papers.*

Sullivan, B. T. (2011, January 2). Academic library autopsy report, 2050. *The Chronicle of Higher Education*. Available from `http://chronicle.com/article/Academic-Library-Autopsy/125767/`

Surowiecki, J. (2005). *The wisdom of crowds*. New York, NY: Random House.

Sutcliffe, A., & Ennis, M. (1998). Towards a cognitive theory of information retrieval. *Interacting with Computers*, *10*(3), 321–351.

Tan, G., & Zhong, Z. (2009). The application of storytelling in digital museums. In Y. Pan, S. Sun, M. Zhou, Z. Lin, Z. Hu, & M. Hyungjae (Eds.), *IEEE 10th international conference on computer-aided industrial design & conceptual design,*

2009. CAID & CD 2009 (p. 1638-1641). Washington, D.C.: IEEE.

Tarulli, L., & Spiteri, L. F. (2012). Library catalogues of the future: A social space and collaborative tool? *Library Trends*, *61*(1), 107-131.

Tedd, L. A. (1994). OPACs through the ages. *Library Review*, *43*(4), 27-37.

Theimer, K. (2012). Archives in context and as context. *Journal of Digital Humanities*, *1*(2). Available from http://journalofdigitalhumanities.org/1-2/archives-in-context-and-as-context-by-kate-theimer/

Toms, E. G. (2002). Information interaction: Providing a framework for information architecture. *Journal of the American Society for Information Science and Technology*, *53*(10), 855-862.

Trant, J. (2006). Social classification and folksonomy in art museums: Early data from the steve.museum tagger prototype. In *17th ASIS SIG/CR classification research workshop.* Available from http://www.archimuse.com/papers/asist-CR-steve-0611.pdf

Trant, J. (2009). Tagging, folksonomy and art museums: Early experiments and ongoing research. *Special Issue of the Journal of Digital Information: Digital Libraries and User-Generated Content*, *10*(1). Available from http://journals.tdl.org/jodi/index.php/jodi/article/view/270/277

Tsai, C.-F. (2007). A review of image retrieval methods for digital cultural heritage resources. *Online Information Review*, *31*(2), 185-198.

Urquhart, C. (2013). *Grounded theory for qualitative research. A practical guide*. London: Sage Publications.

Visser, J. (2010). *The new website and semantic network of the museum of national history* (Blog post). The museum of the future. Available from http://themuseumofthefuture.com/2010/11/17/the-new-website-and-semantic-network-of-the-museum-of-national-history/

Visser, J. (2011). *Bumpy rides and dead-end streets* (Blog post). The museum of the future. Available from http://themuseumofthefuture.com/2011/07/05/bumpy-rides-and-dead-end-streets/

Vliet, H. v., & Hekman, E. (2012). Enhancing user involvement with digital cultural heritage: The usage of social tagging and storytelling. *First Monday*, *17*. Available from http://journals.uic.edu/ojs/index.php/fm/article/view/3922

Waibel, G., & Erway, R. (2009). Think global, act local - library, archive and museum collaboration. *Museum Management and Curatorship*, *24*(4), 323-335.

Wal, V. (2007). *Folksonomy: Folskonomy coinage and definition* (Definition). Thomas

Vander Wal's, vanderwal.net. Available from http://vanderwal.net/folksonomy.html

Walia, P. K., & Gupta, M. (2012). Application of web 2.0 tools by national libraries. *Webology*, *9*(2). Available from http://www.webology.org/2012/v9n2/a99.html

Waller, V. (2009). What do the public search for on the catalogue of the state library of victoria? *Australian Academic & Research Libraries*, *40*(4), 266-285.

Waterworth, J., & Chignell, M. (1991). A model of information exploration. *Hypermedia*, *3*(1), 35–58.

Weil, S. E. (1999). From being about something to being for somebody: The ongoing transformation of the american museum. *Daedalus*, *128*(3), 229-258.

Welie, M. V., & Veer, G. C. V. D. (2003). Pattern languages in interaction design: Structure and organization. In M. Rauterberg, M. Menozzi, & J. Wesson (Eds.), *Proceedings of INTERACT'03: IFIP TC13 international conference on human-computer interaction* (p. 527-534). Amsterdam: IOS Press.

White, R., & Roth, R. (2009). Exploratory search: Beyond the query-response paradigm. *Synthesis Lectures on Information Concepts, Retrieval, and Services*, *1*(1), 1-98.

Wythe, D. (2007). New technologies and the convergence of libraries, archives, and museums. *RBM: A Journal of Rare Books, Manuscripts, and Cultural Heritage*, *8*(1), 51-55.

Xie, I. (2009). Information searching and search models. In M. Bates & M. N. Maack (Eds.), *Encyclopedia of library and information sciences* (3rd ed., p. 2592-2604). Boca Raton, FL: CRC Press.

Yakel, E. (2004). Encoded archival description: Are finding aids boundary spanners or barriers for users? *Journal of Archival Organization*, *2*(1-2), 63-77.

Yakel, E., Shaw, S., & Reynolds, P. (2007). Creating the next generation of archival finding aids. *D-Lib Magazine*, *13*(5/6). Available from http://www.dlib.org/dlib/may07/yakel/05yakel.html

Yi, K., Beheshti, J., Cole, C., Leide, J. E., & Large, A. (2006). User search behavior of domain-specific information retrieval systems: An analysis of the query logs from psycinfo and abc-clio's historical abstracts/america: History and life. *Journal of the American Society for Information Science and Technology*, *57*(9), 1208-1220.

Zhang, J. (2012). Archival representation in the digital age. *Journal of Archival Organization*, *10*(1), 45-68.

Zhang, X. M., Li, Y. L., Liu, J. J., & Zhang, Y. (2008). Effects of interaction design in digital libraries on user interactions. *Journal of Documentation*, *64*(3), 438-463.

Appendices

APPENDIX A

Sample of Use Cases

Table A.1 shows the systems from the initial sample which were the basis of developing the framework described in chapter 5. The links and characteristics were collected in December 2011. To ensure the links are all still working, they were all last accessed on August 26, 2013.

Table A.1.: List of all systems belonging to the initial sample (the basis for the grounded theory development).

Name	URL	Country
Archives Portal Europe	http://www.archivesportaleurope.eu/	ES
ArtBabble	http://www.artbabble.org/	US
Beeld en Geluid	http://www.beeldengeluid.nl/	NL
Brooklyn Museum	http://www.brooklynmuseum.org/	US
Columbia University Libraries Digital Collections	http://library.columbia.edu/find/digital-collections.html	US
Dahesh Museum of Art	http://www.daheshmuseum.org/	US
David Rumsey Map Collection	http://www.davidrumsey.com/	US
Der interaktive Katalog des Münzkabinetts	http://www.smb.museum/ikmk/	DE
Deutsches Bundesarchiv	http://www.bundesarchiv.de/	DE
Europeana	http://www.europeana.eu/	NL

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Table A.1 – *Continued from previous page*

Name	URL	Country
Gallica	http://gallica.bnf.fr/	FR
Google Art Project	http://www.googleartproject.com/	US
HathiTrust	http://www.hathitrust.org/	US
Historypin	http://www.historypin.com/	UK
ICDL - International Children's Digital Library	http://www.childrenslibrary.org/	US
Library of Congress Digital Collections	http://www.loc.gov/library/libarch-digital.html	US
LibraryThing	http://www.librarything.de/	US
Louvre	http://www.louvre.fr/	FR
Mapping our Anzacs	http://mappingouranzacs.naa.gov.au/	AU
Maritiem Digitaal	http://www.maritiemdigitaal.nl/	NL
Maryland Digital Cultural Heritage	http://www.mdch.org/	US
Minnesota Historical Society	http://www.mnhs.org/	US
La Piscine-Musée d'Art et d'Industrie André Diligent	http://www.roubaix-lapiscine.com/	FR
Museum of Jewish Heritage	http://www.mjhnyc.org/	US
Nationaal Archief	http://www.nationaalarchief.nl/	NL
Nationaal Historisch Museum	http://www.innl.nl/	NL
Olga's Gallery	http://www.abcgallery.com/	US
Open Images	http://www.openimages.eu/	NL
Perseus Digital Library	http://www.perseus.tufts.edu/	US
Philaplace	http://www.philaplace.org/	US
Polar Bear Expedition Digital Collections	http://quod.lib.umich.edu/p/polaread/	US
Project Gutenberg	http://www.gutenberg.org/	US
Rijksmuseum	http://www.rijksmuseum.nl/	NL

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Table A.1 – *Continued from previous page*

Name	URL	Country
Saatchi Gallery Online	http://www.saatchionline.com/	UK
ShelfLife DPLA Demo	http://librarylab.law.harvard.edu/dpla/demo/app/	US
Smithsonian Institution Collections Search Center	http://collections.si.edu/	US
Städel Museum	http://www.staedelmuseum.de/	DE
Steve Tagger	http://tagger.steve.museum/	US
Tate	http://www.tate.org.uk/	UK
The Athenaeum	http://www.the-athenaeum.org/	UK
The British Museum	http://www.britishmuseum.org/	UK
The European Library	http://www.theeuropeanlibrary.org/	NL
The First World War Poetry Digital Archive	http://www.oucs.ox.ac.uk/ww1lit/	UK
The Frick Collection	http://www.frick.org/	US
The Metropolitan Museum of Art	http://www.metmuseum.org/	US
The State Hermitage Museum	http://www.hermitagemuseum.org/	RU
Victoria and Albert Museum	http://collections.vam.ac.uk/	UK
Walker Art Center	http://www.walkerart.org/	US
World Digital Library	http://www.wdl.org/	US
Your Paintings	http://www.bbc.co.uk/arts/yourpaintings/	UK

APPENDIX B

Case Study and Data Analysis

The development of the framework for interactions in cultural heritage information systems is explained in detail using grounded theory as a data analysis method. Some of the tables and the approach on presenting the workflow of the grounded theory and coding are inspired by the book on grounded theory by Urquhart (2013), in particular chapter 8 (Urquhart, 2013, p. 148-174). The data analysis and development of the framework was conducted between December 2011 and February 2012.

In a first iteration, the systems were open coded looking for interactions related to access and user engagement. The emphasis was on broad terms rather than single interactions such as 'logging in' or 'clicking a link'. There were mainly used to generate a big picture about interactions and access in cultural heritage. These codes were then grouped into broader concepts. This process is often called selective coding *"where open codes are organized into selective codes"* (Urquhart, 2013, p. 49) (here called 'concepts'). Table B.1 shows a snapshot of all the codes which were found to describe interactions in the systems and their concepts.

From these concepts and codes, it emerged that there are three main groups of interactions, categories, that are either dealing with content representation, user representation or social features (see table B.2).

Table B.3 shows an overview of all open codes that were assigned to the different information systems grouped by the categories that emerged through the grounded theory approach. Combining the open codes with the three categories content representation, user representation and social features was chosen to improve the understanding of the process and make it more transparent. For the open

Table B.1.: Grouping codes into concepts based on case study with grounded theory approach.

Concepts	Codes
Browsing functionalities	Timeline, map browsing, themes, pivot browsing, channels
Full view	Metadata, thumbnails, outgoing links, full screen
Object display	Item rotation, zooming, enlarging, thumbnails
Search functionalities	Simple search, advanced search, autocompletion, search by color or layout
Search result presentation	Facets, refine by color, refine by layout, thumbnails
Sharing	Social media buttons, RSS, blogs, twitter
Storytelling	Narratives,
User account	Profiles, logging, saved searches, avatars
User annotations	Tagging, rating, comments, tagging games
User exhibitions	Albums, slideshows, virtual exhibitions

Table B.2.: Grouping concepts into categories based on case study with grounded theory approach.

Categories	Concepts
Content representation	Browsing functionalities, full view display, object display, search functionalities, search result presentation
User representation	User account
Social features	Sharing, storytelling, user annotations, user exhibitions

coding, it was not important to be exhaustive and representative with the interactions coded. Here, it was mainly important to list extremes and built up a scale of possible interactions.

Table B.3.: List of codes per system grouped by categories(basis of the grounded theory).

System Name	Content Representation	User Representation	Social Features
Archives Portal Europe	Finding aids, search	No user representation	No social features
ArtBabble	Full-text search, thumbnail, snippets, faceted search, classification which enables pivot browsing, channels, comments, videos, full-screen, play of videos, full text search, simple search, popular & recent items on Homepage, channels, series, artists and organizations	User's profile is only public, when comment was posted to a video, active people can be found, profile search not possible	See comments of other users
Beeld en Geluid	Mix of all media types, with faceted search, media only search results just have thumbnails with metadata when hovered over, no quick scanning of search results info, tags	Favoring objects	Sharing and embedding, only social features but not upload for users and collaboratively working on objects & Social media channels

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Table B.3 – *Continued from previous page*

System Name	Content Representation	User Representation	Social Features
Brooklyn Museum	3 columns with snippets and thumbnail, query highlighting in search results, grouping of results according to semantics, rich metadata with bigger pics, quality indicator with record completeness, social discussions, simple search, advanced search, tags are indexed but no refinement by tags, browse by name of collections and exhibition on display	Public profiles, no following, searching for users, no same interest matches	Link to your favorite collection or email objects, collaborative tagging, user can comment and tag, all tags are public, everyone can delete tags, tagging game for deleted tags, stats about tags of users, tagging for metadata enrichment, tag-resource-user relationship, add objects to favorite collection
Columbia University Libraries Digital Collections	Faceted search, simple and advanced search, virtual exhibitions, several search results lists	User account for managing library services	No social functionalities
Dahesh Museum of Art	List with snippets, metadata text, accession number enlargement, zoomify, simple search, browse by artist, or type (painting, sculpture), browse additional artworks of creators, artwork of the month	No user account	E-cards, vote for the nicest artwork of the permanent collection
David Rumsey Map Collection	Zoom and work space browsing, simple search, advanced search, "luna browser" with many functionalities, browsing by who, what, where, when	User account	Embedded sharing button, save user exhibitions

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Table B.3 – *Continued from previous page*

System Name	Content Representation	User Representation	Social Features
Der interaktive Katalog des Münzkabinetts	Thumbnails, title, numismatic-specific metadata, expert vocabulary, simple search box, advanced search seems to be for experts	No user account, but objects can be saved based on cookies	Crowdfunding for digitizing more coins, moderated comment functionality, send in by mail, then published
Deutsches Bundesarchiv	Finding aid display	No user account	No social features
Europeana	Thumbnails, link to provider, simple search, related items, browsing, enrichments with thesauri for subject keywords, enrichment with Wikipedia links and vocabularies, translation of full view, user-contributions can be searched	User account	Social sharing buttons, save search and tags, not public
Gallica	Advanced search, simple search, specialize collections	Feedback	Sharing channels
Google Art Project	Zooming, contextualization of objects (videos and biographies of artists)	User account (Google account)	Sharing options, user exhibitions, enrich with videos, annotate with free text

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Table B.3 – *Continued from previous page*

System Name	Content Representation	User Representation	Social Features
HathiTrust	Short snippet and title, links to record and full view if its in the public domain, access to the whole document if public domain, switch across the different views, thumbnails catalogue search or within record search, browse a list which can be sorted by title	Accounts are actually limited to members of partner institutions	No social features
Historypin	Slide show, presentation mode, add your story to every public photo, map search	User account, avatar	Common channels like Google+, Twitter and Facebook, user exhibitions, storytelling, tagging, all collaborative
ICDL	Simple search, advanced search, color facet, curated exhibitions	user account, avatars	Community, user review, upload drawings related to books, voting for books
Library of Congress Digital Collections	Access to print, pictorial and audiovisual collections and other digital services, depending on collection, no cross-collection search functionality	User account for managing library services	Share buttons
LibraryThing	Recommended lists, recommendations	User profile, account	Groups, tagging discussion, collaborative tagging, voting
Louvre	Full screen mode, item rotation display and list	User account, avatar, no public profile	User can bookmark items, multimedia channels

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Table B.3 – *Continued from previous page*

System Name	Content Representation	User Representation	Social Features
Mapping our Anzacs	Map integration, PDF views, within PDF search	No user representation	Share buttons
Maritiem Digitaal	User comments can be searched	No user account needed for commenting, no login, comments	No social features
Maryland Digital Cultural Heritage	Featured collection	No user account	No social features
Minnesota Historical Society	list of resources, no meta search	No user account	No social features
Musée La Piscine de Roubaix	Full text description with every objects, historical context, search works only with autocompleted terms	No user account	No social features
Museum of Jewish Heritage	Thumbnails and type of content displayed, search result presentation as slideshow or mosaic view, controlled vocabulary for subjects, deep zoom, simple search, advanced search, featured item on homepage	No user account	no social feature
Nationaal Archief	Meta-search across resources	User account	Crowd sourced transcriptions of documents, group discussions
Nationaal Historisch Museum	Extensive cross linking, storytelling, guided workflows for better metadata creation of users	User account, avatar, profile, public profile with activity stream	Collaboration on stories and exhibitions

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Table B.3 – *Continued from previous page*

System Name	Content Representation	User Representation	Social Features
Olga's Gallery	No search, just browsing, then presenting in a list with thumbnails metadata, large picture, additional text provided by site owner	No user activities, poster ordering	Social media buttons
Open Images	Thumbnail and metadata - one view video, detailed description, social media buttons and possibility to add tags, full screen mode, simple search, advanced search	User and institution have the same hierarchy in accounts, favorite media items which show up in a favorite list in user profile	Favorites are not publicly visible and it is not visible at the videos which ones were favorited, adding tags
Perseus Digital Library	Textual content for expert users, popular texts, exhibits, word counts per document, data analysis	No user account	No social features
Philaplace	User content, maps integration	User account	Storytelling, tagging
Polar Bear Expedition Digital Collections	Browsable finding aids	no account	Saving item to "book bag"
Project Gutenberg	Search, browse	Cookies enabled for bookmarking items, no user account	Sharing
Rijksmuseum	Search by color, count of likes	User account	Public sets and exhibitions
Saatchi Gallery Online	Search and browsing functionalities with facts fitting the content, browse across themes, favorite items	User accounts for artists and collectors, profiles	Sharing options, commenting

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Table B.3 – *Continued from previous page*

System Name	Content Representation	User Representation	Social Features
ShelfLife DPLA Demo	Browsing functionality based on stats on borrowing	No user account	No sharing option
Smithsonian Institution Collections Search Center	Refine search	User account	Tagging, lists can be saved based on session, voting on tags of others
Städel Museum	Browsing via collections, biographies of artists	No user account	E-cards, sharing to third sites
Steve Tagger	List facets, creator title tags, metadata, related items enlarged as overlay, tag cloud	User account	Public exhibitions which can be edited by users, social tagging, multilingual
Tate	Artists search, browsing functionalities	User account	Social sharing
The Athenaeum	Browsing functionalities	User profile with stats on activity, vote on objects, users upload content, average vote displayed with each object	Private or public lists, everyone can correct metadata and upload
The British Museum	Curated objects, highlights of the museum with a lot of explanatory text, browsing across themes breadcrumb navigation shows the depth of browsing	No profile	No social features
The European Library	Featured collections, browsing functionalities, map integration	User account	Social media channels
The First World War Poetry Digital Archive	Simple & advanced search, curated collections	No user account	Favorite items per session

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Table B.3 – *Continued from previous page*

System Name	Content Representation	User Representation	Social Features
The Frick Collection	Virtual tour of museum, metadata specifies location of object in museum, browsable collection, zoomify	No user account	User exhibitions in demo version
The Metropolitan Museum of Art	Timeline thematic by collection, very nicely curated content, browse highlights, contextualization through who, what, where, when facets	User account	Set of your favorite items, but not public, sharing widget on object level
The State Hermitage Museum	Layout search	No account	No social features
Victoria and Albert Museum	Curated collections, integrated map	User account	Share button
Walker Art Center	Facets by decade, zoom	Portrait of members but no real user account	Facebook comment feature
World Digital Library	Map browsing and timeline browsing are prominent	User account	Social media buttons
Your Paintings	Simple search, refine facets	User account for tagging	Guided tagging workflow, sharing, user exhibition

These three steps presented here in a chronological order were less directed and straightforward in the execution. Between open coding of the interactions per system and the development of concepts and categories many steps back and forth were taken until the categories emerged.

With the study of literature, it was clear that there is a focus on creational activities for users within certain information systems. These are namely user exhibitions, social tagging and storytelling. These were the categories used for creational user activities. For content representation, there was a need to distinguish between user and institutional content (see also chapter 5). All the other activities

were rather for easing creational activities through saving exhibitions and return to them later. Therefore, the need emerged to cluster interactions that have a supportive character. These classes were considered to be the *Support* classes.

Table B.3 revealed that on the one hand there are similar interactions in different information systems but that on the other hand they have different qualities. In this regard, two concepts emerged throughout *Contextualization* and *Collaboration*. Both are rather qualities of different interaction groups as they appear in content representation as well as creational user activities. It emerged that there is scale of these qualitative attributes where collaboration is the highest possible interaction form.

APPENDIX C

Content Analysis - Sample

Following, the systems in their different groups analyzed in chapter 6 are listed. They were used for the content analysis. To ensure the links are still working, they were all last accessed on August 26, 2013. The underlined system in each table was used for the analytical evaluation in chapter 7.

Table C.1.: List of all systems belonging to the *Museums* group.

Name	**URL**	**System type**	**Country**
ArtBabble	http://www.artbabble.org/	Collection, Museum, Aggregator	US
Brooklyn Museum	http://www.brooklynmuseum.org/	Museum, Community	US
Dahesh Museum of Art	http://www.daheshmuseum.org/	Museum	US
Der interaktive Katalog des Münzkabinetts	http://www.smb.museum/ikmk/	Museum, Collection	DE
Getty Museum	http://www.getty.edu/museum/	Museum	US
Google Art Project	http://www.googleartproject.com/	Aggregator, Museum	US
Louvre	http://www.louvre.fr/	Museum	FR
Maritiem Digitaal	http://www.maritiemdigitaal.nl/	Collection, Museum	NL

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Table C.1 – *Continued from previous page*

Name	URL	System type	Country
Maryland Digital Cultural Heritage	http://www.mdch.org/	Collection, Museum	US
Musée d'Orsay	http://www.musee-orsay.fr/	Museum	FR
La Piscine-Musée d'Art et d'Industrie André Diligent	http://www.roubaix-lapiscine.com/	Museum	FR
Museum of Jewish Heritage	http://www.mjhnyc.org/	Museum	US
Museum of Modern Art	http://www.moma.org/	Museum	US
Nationaal Historisch Museum	http://www.innl.nl/	Museum, Community	NL
National Gallery of Art	http://www.nga.gov/	Museum	US
National Gallery, London	http://www.nationalgallery.org.uk/	Museum	UK
National Museum of Korea	http://www.museum.go.kr/	Museum	KR
National Palace Museum	http://www.npm.gov.tw/	Museum	TW
National Portrait Gallery	http://www.npg.org.uk/	Museum	UK
Philaplace	http://www.philaplace.org/	Community, Collection, Museum	US
Rijksmuseum	http://www.rijksmuseum.nl/	Museum	NL
Saatchi Gallery Online	http://www.saatchionline.com/	Community, Museum	UK
Smithsonian Collections Search Center	http://collections.si.edu/	Aggregator, Museum	US
Städel Museum	http://www.staedelmuseum.de/	Museum	DE
Steve Tagger	http://tagger.steve.museum/	Collection, Museum	US
Tate	http://www.tate.org.uk/	Museum	UK
The British Museum	http://www.britishmuseum.org/	Museum	UK

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Table C.1 – *Continued from previous page*

Name	URL	System type	Country
The Frick Collection	http://collections.frick.org/	Museum	US
The Metropolitan Museum of Art	http://www.metmuseum.org/	Museum	US
The State Hermitage Museum	http://www.hermitagemuseum.org/	Museum	RU
Victoria and Albert Museum	http://collections.vam.ac.uk/	Museum	UK
Walker Art Center	http://www.walkerart.org/	Museum	US
Whitney for Kids	http://whitney.org/ForKids	Community, Museum	US
Your Paintings	http://www.bbc.co.uk/arts/yourpaintings/	Aggregator, Museum	UK

Table C.2.: List of all systems belonging to the *Libraries* group.

Name	Website	System type	Country
British Library	http://www.bl.uk/	Library	UK
Columbia University Libraries Digital Collections	http://library.columbia.edu/find/digital-collections.html	Library	US
Deutsche Bibliothek	http://www.dnb.de/	Library	DE
Gallica	http://gallica.bnf.fr/	Aggregator, Library	FR
HathiTrust	http://www.hathitrust.org/	Aggregator, Library	US
Havard University Library	http://hul.harvard.edu/	Library	US
ICDL	http://www.childrenslibrary.org/	Collection, Library	US
Library of Congress Digital Collections	http://www.loc.gov/library/libarch-digital.html	Library	US
LibraryThing	http://www.librarything.de/	Community, Library	US
National Library of Canada	http://www.collectionscanada.gc.ca/	Library	CA
New York Public Library	http://www.nypl.org/	Library, Community	US
Perseus Digital Library	http://www.perseus.tufts.edu/	Collection, Library	US
Project Gutenberg	http://www.gutenberg.org/	Library, Aggregator, Collection	US
The European Library	http://www.theeuropeanlibrary.org/	Aggregator, Library	NL
Trove	http://trove.nla.gov.au/	Community, Archive, Library	AU
Universitätsbibliothek HU-Berlin	http://www.ub.hu-berlin.de/	Library	DE
World Digital Library	http://www.wdl.org/	Aggregator, Library	US
Yale University Library	http://www.library.yale.edu/	Library	US

Table C.3.: List of all systems belonging to the *Archives* group.

Name	URL	System type	Country
Archives Nationales	http://www.archivesnationales.culture.gouv.fr	Archive	FR
Archives Portal Europe	http://www.archivesportaleurope.eu/	Aggregator, Archive	ES
Archivo Historico Nacional	http://www.mcu.es/archivos/	Archive	ES
Beeld en Geluid	http://www.beeldengeluid.nl/	Archive	NL
Deutsches Bundesarchiv	http://www.bundesarchiv.de/	Archive	DE
Minnesota Historical Society	http://www.mnhs.org/	Archive	US3
Narodni Archiv	http://www.nacr.cz/	Archive	CZ
Nationaal Archief	http://www.gahetna.nl/	Archive	NL
National Archives	http://www.archives.gov/	Archives	US
Open Images	http://www.openimages.eu/	Collection, Archive	NL
Österreichisches Staatsarchiv	http://www.oesta.gv.at/	Archive	AT
Polar Bear Expedition Digital Collections	http://quod.lib.umich.edu/p/polaread/	Collection, Archive	US
The First World War Poetry Digital Archive	http://www.oucs.ox.ac.uk/ww1lit/	Collection, Archive	UK
The National Archives	http://www.nationalarchives.gov.uk/	Archive	UK
Trove	http://trove.nla.gov.au/	Community, Archive, Library	AU

Table C.4.: List of all systems belonging to the *Aggregators* group.

Name	URL	System type	Country
Archives Portal Europe	http://www.archivesportaleurope.eu/	Aggregator, Archive	ES
ArtBabble	http://www.artbabble.org/	Collection, Museum, Aggregator	US
DPLA	http://www.dp.la/	Aggregator	US
Europeana	http://www.europeana.eu/	Aggregator	NL
Gallica	http://gallica.bnf.fr/	Aggregator, Library	FR
Google Art Project	http://www.googleartproject.com/	Aggregator, Museum	US
HathiTrust	http://www.hathitrust.org/	Aggregator, Library	US
Project Gutenberg	http://www.gutenberg.org/	Library, Aggregator, Collection	US
Smithsonian Collections Search Center	http://collections.si.edu/	Aggregator, Museum	US
The European Library	http://www.theeuropeanlibrary.org/	Aggregator, Library	NL
World Digital Library	http://www.wdl.org/	Aggregator, Library	US
Your Paintings	http://www.bbc.co.uk/arts/yourpaintings/	Aggregator, Museum	UK

Table C.5.: List of all systems belonging to the *Collections* group.

Name	URL	System type	Country
ArtBabble	http://www.artbabble.org/	Collection, Museum, Aggregator	US
David Rumsey Map Collection	http://www.davidrumsey.com/	Collection	US
Der Interaktive Katalog des Münzkabinetts	http://www.smb.museum/ikmk/	Museum, Collection	DE
ICDL	http://www.childrenslibrary.org	Collection, Library	US
Maritiem Digitaal	http://www.maritiemdigitaal.nl/	Collection, Museum	NL
Maryland Digital Cultural Heritage	http://www.mdch.org/	Collection, Museum	US
Olga's Gallery	http://www.abcgallery.com/	Collection	US
Open Images	http://www.openimages.eu/	collection, Archive	NL
Perseus Digital Library	http://www.perseus.tufts.edu/	Collection, Library	US
Philaplace	http://www.philaplace.org/	Community, Collection, Museum	US
Polar Bear Expedition Digital Collections	http://quod.lib.umich.edu/p/polaread/	Collection, Archive	US
Project Gutenberg	http://www.gutenberg.org/	Library, Aggregator, Collection	US
Steve Tagger	http://tagger.steve.museum/	Collection, Museum	US
The Athenaeum	http://www.the-athenaeum.org/	Collection, Community	UK
The First World War Poetry Digital Archive	http://www.oucs.ox.ac.uk/ww1lit/	Collection, Archive	UK

Table C.6.: List of all systems belonging to the *Communities* group.

Name	URL	System type	Country
Brooklyn Museum	http://www.brooklynmuseum.org/	Museum, Community	US
Historypin	http://www.historypin.com/	Community	US
LibraryThing	http://www.librarything.de/	Community, Library	US
Nationaal Historisch Museum	http://www.innl.nl/	Museum, Community	NL
New York Public Library	http://www.nypl.org/	Library, Community	US
Philaplace	http://www.philaplace.org/	Community, Collection, Museum	US
Saatchi Gallery Online	http://www.saatchionline.com/	Community, museum	UK
The Athenaeum	http://www.the-athenaeum.org/	Collection, Community	UK
Trove	http://trove.nla.gov.au/	Community, Archive, Library	AU
Whitney for Kids	http://whitney.org/ForKids	Community, Museum	US

APPENDIX D

Codebook

The coding was performed with a coding from (see appendix E). The code form ensured consistency and was developed as a survey with multiple choices for each section relevant for interactions. Figure E.1 shows a screenshot of the code form. It has seven areas that relate to the seven interactions classes and was based on the coding form. The following tables lists the characteristic interactions of each degree per interaction class and how it is coded (from 0-5).

To evaluate a system, the author marked all fields that applied for the seven statements in the code form. All interactions that could be found in a system were marked. For the evaluation, only the highest degree of interaction (corresponding to the highest number of code in the codebook was used), as the degrees of interaction built upon another. The degree of interaction for each information system is determined by highest code number.

Institutional Objects

Table D.1.: First area of characteristics and their coding.

Degree	Characteristic	Code
-	No search for cultural heritage objects is offered.	0
Basic Functionality	I can search for cultural heritage objects.	1
Organization	I can refine the search result with facets or filters or search in certain fields.	2
	I can search or browse by color or content characteristics.	2
Enrichment	I can deep zoom into the objects or enlarge them.	3
	I can view virtual exhibitions curated by professionals.	3
	The object is enriched with additional internal information.	3
Contextualization	On the object page, I can follow outgoing links to more information like Wikipedia or other external resources.	4
Collaboration	I can edit objects and their information on the object page.	5

User Objects

Table D.2.: Second area of characteristics and their coding.

Degree	Characteristic	Code
-	I cannot upload something to the system or I cannot search for user objects.	0
Basic Functionality	I can upload objects to the system.	1
	I can search for objects uploaded by other users.	1
Organization	I can add my own descriptions to my uploaded material.	2
Enrichment	I can add links to other information and embed my objects within other resources of the system.	3
Contextualization	I can embed other material from external resources, like videos or such, with the uploaded objects.	4
Collaboration	I can edit other users' objects and all information on the object page	5

Annotations

Table D.3.: Third area of characteristics and their coding

Degree	Characteristic	Code
-	There is no feature for annotating objects provided.	0
Basic Functionality	I can add a tag to an object.	1
	I can add comments or other annotations to an object.	1
Organization	I can search for the tags or annotations I added.	2
	I can find at least one tag or annotation to any resource that was assigned by another user.	2
Enrichment	I can see which user assigned this tag or annotation.	3
	I can add person, events and locations.	3
Contextualization	On another user's profile, I can see which tags or annotations she assigned to which objects.	4
	I can add external resources to my tags or annotations.	4
Collaboration	I can delete or edit tags or annotations other people added.	5
	I decide within a community about the usefulness of annotations.	5

User Exhibitions

Table D.4.: Fourth area of characteristics and their coding.

Degree	Characteristic	Code
-	There is no feature to save my favorite items.	0
Basic Functionality	I can save or bookmark objects to a list or my account.	1
Organization	I can reorder the saved or bookmarked items, often called exhibition, in the way I want.	2
	I can publish or share the exhibition I created.	2
Enrichment	I can add my own description to the exhibition or the different items in it.	3
Contextualization	I can add links or videos or resources from third-party sites to the exhibition.	4
	On an object page, I can see if an objects belongs to a user exhibitions.	4
Collaboration	Other people can add additional information to my exhibition.	5

Storytelling

Table D.5.: Fifth area of characteristics and their coding.

Degree	Characteristic	Code
-	There is no feature to tell stories.	0
Basic Functionality	I can tell a story about objects on the site.	1
Organization	I can reorder items and define a title for the story.	2
Enrichment	I can add my own description (participating people, places where story took place) to the story or the items in it.	3
Contextualization	I can use maps and timelines for my story and add videos or other pictures.	4
	I can upload my own objects and add them to the story.	4
Collaboration	I can add additional information to other users' stories.	5

User Representation

Table D.6.: Sixth area of characteristics and their coding.

Degree	Characteristic	Code
-	There is no user account.	0
Basic Functionality	I can log into my own account.	1
	I can change settings or I can upload my own profile picture.	1
Organization	My user profile is publicly visible.	2
	I can search for my user name in the system.	2
Enrichment	On an object page, I can see if other users interacted with it.	3
	I can go to another user's profile and see her actions.	3
Contextualization	I can follow activities of other users in a stream.	4
Collaboration	I can invite other people to a group for collaboration.	5

User & Content Reputation

Table D.7.: Seventh area of characteristics and their coding.

Degree	Characteristic	Code
-	I cannot vote for an object and do not see what other users voted for.	0
Basic Functionality	I can vote for objects, tags or other user contributions or favorite them, press a like button or heart	1
	Each user contribution or action in the system is counted.	1
Organization	Each objects description shows how often the objects is liked.	2
	I see on my profile how often I contributed.	2
Enrichment	I can see the objects other users voted for.	3
	On each object, I see who voted for it.	3
Contextualization	Popular objects are featured.	4
	My user account shows stats and other information about my contributions.	4
Collaboration	Other users rate my contributions which adds to my overall reputation.	5
	I reach privileges (more editing rights) if I contributed well to the system.	5

APPENDIX E

Code Form

Following, the code form that was followed to assign the degrees for each interaction class. The code form was created with Google Drive[1].

Institutional Objects

You start on the Homepage looking for a search box, please mark all fields which apply here.

- ○ No search for cultural heritage objects is offered.
- ○ I can search for cultural heritage objects.
- ○ I can refine the search result with facets or filters or search in certain fields.
- ○ I can search or browse by color or content characteristics.
- ○ I can deep zoom into the objects or enlarge them.
- ○ I can view virtual exhibitions curated by professionals.
- ○ The object is enriched with additional internal information.
- ○ On the object page, I can follow outgoing links to more information like Wikipedia or other external resources.

[1] https://drive.google.com/ last accessed October 25, 2013.

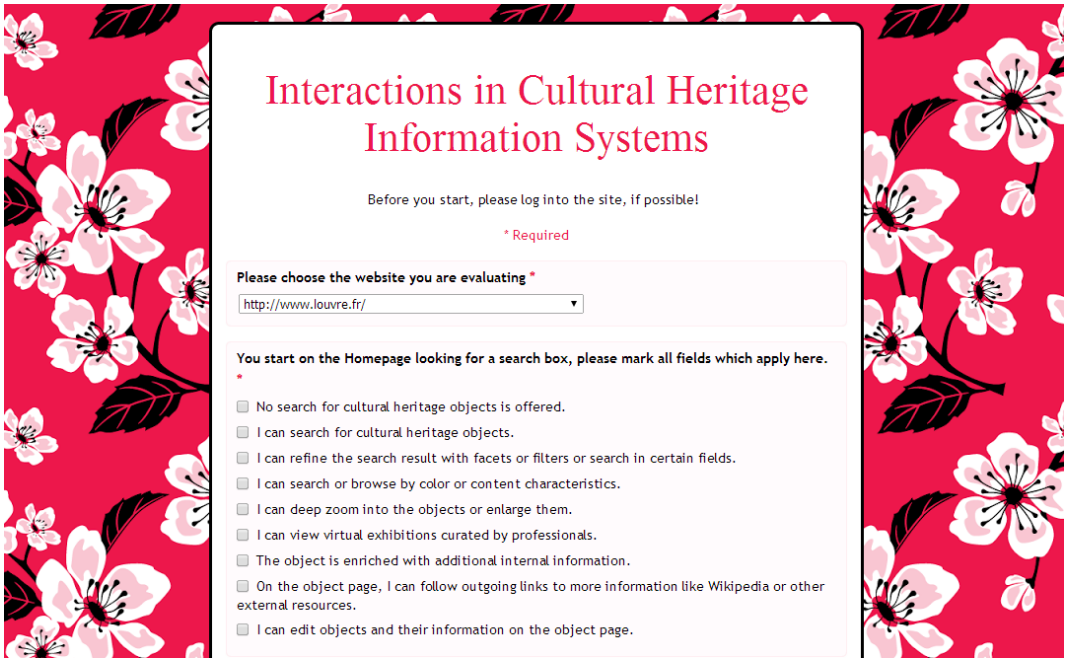

Figure E.1.: Screenshot of the code form in Google Drive.

- I can edit objects and all information on the object page.

User Objects

Look for a feature that lets you upload your own material.

- I cannot upload something to the system or I cannot search for user objects.
- I can upload objects to the system.
- I can search for objects uploaded by other users.
- I can add my own descriptions to my uploaded material.
- I can add links to other information and embed my objects within other resources of the system.
- I can embed other material from external resources, like videos or such, with the uploaded objects.
- I can edit other users' objects and all information on the object page.

Annotations

Look for free text annotations, comments and social tags and mark all fields which apply here.

- ○ There is no feature for annotating objects provided.
- ○ I can add a tag to an object.
- ○ I can add comments or other annotations to an object.
- ○ I can search for the tags or annotations I added.
- ○ I can find at least one tag or annotation to any resource that was assigned by another user.
- ○ I can see which user assigned this tag or annotation.
- ○ I can add person, events and locations.
- ○ On another user's profile, I can see which tags or annotations she assigned to which objects.
- ○ I can add external resources to my tags or annotations.
- ○ I can delete or edit tags or annotations other people added.
- ○ I decide within a community about the usefulness of annotations.

User Exhibitions

Look for a feature which lets you save your favorite object or several favorite objects of the collections.

- ○ There is no feature to save my favorite items.
- ○ I can save or bookmark objects to a list or my account.
- ○ I can reorder the saved or bookmarked items, sometimes called exhibition, in the way I want.
- ○ I can publish or share the exhibition I created.

- I can add my own description to the exhibition or the different items in it.
- I can add links or videos or resources from third-party sites to the exhibition.
- On a object page, I can see if an objects belongs to a user exhibitions.
- Other people can add additional information to my exhibition.

Storytelling

Look for feature where you can tell a story or a chronological narrative.

- There is no feature to tell stories.
- I can tell a story about objects on the site.
- I can reorder items and define a title for the story.
- I can add my own description (participating people, places where story took place) to the story or the items in it.
- I can use maps and timelines for my story and add videos or other pictures.
- I can upload my own objects and add them to the story.
- Other users can add additional information to my story.

User Representation

Look for a user account and mark all fields which apply here.

- There is no user account.
- I can log into my own account.
- I can change settings or I can upload my own profile picture.
- My user profile is publicly visible.
- I can search for my user name in the system.

- On an object page, I can see if other users interacted with it.
- I can go to another user's profile and see her actions.
- I can follow activities of other users in a stream.
- I can invite other people to a group for collaboration.

User & Content Reputation

Go to an objects of your choice as a starting point and mark all fields which apply here.

- I cannot vote for an object and do not see what other users voted for.
- I can vote for objects, tags or user contributions or favorite them, press a like button or heart.
- Each user contribution or action in the system is counted.
- Each objects description shows how often the objects is liked.
- I see on my profile how often I contributed.
- I can see the objects other users voted for.
- On each object I see who voted for it.
- Popular objects are featured.
- My user account shows stats and other information about my contributions.
- Other users rate my contributions which adds to my overall reputation.
- I reach privileges (more editing rights) if I contributed well to the site.

APPENDIX F

Results of Content Analysis

The following tables show the coding for each group based on the codebook (appendix D). The degree for each interaction class per system is referred to in a number from 0 to 5. The degree is determined by the highest number the system reached per class. This number is the one that is shown in the tables of this appendix and translates back to the interaction degree. The following list is a legend for the heading's name used in each table:

- 1. class = Institutional Objects class
- 2. class = User Objects class
- 3. class = Annotations class
- 4. class = User Exhibitions class
- 5. class = Storytelling class
- 6. class = User Representation class
- 7. class = User & Content Reputation class

In each table the underlined cells show the information system of the analytical evaluation of chapter 7. The ICDL and the Brooklyn Museum are listed twice as they belong to two groups of system types.

Table F.1.: Coding of interactions in the *Museums* group.

	Content classes		**Curation classes**			**Support classes**	
System Name	1. class	2. class	3. class	4. class	5. class	6. class	7. class
ArtBabble	3	0	1	0	0	0	0
Brooklyn Museum	3	0	5	2	0	4	4
Dahesh Museum of Art	2	0	0	0	0	0	0
Der interaktive Katalog des Münzkabinetts	2	0	0	1	0	0	0
Getty Museum	3	0	0	2	0	1	0
Google Art Project	4	0	1	4	0	1	0
Louvre	3	0	0	1	0	1	0
Maritiem Digitaal	3	1	3	1	0	0	0
Maryland Digital Cultural Heritage	3	0	0	0	0	0	0
Musée d'Orsay	3	0	0	1	0	0	0
La Piscine-Musée d'Art et d'Industrie André Diligent	3	0	0	0	0	0	0
Museum of Jewish Heritage	3	0	0	0	0	0	0
Museum of Modern Art	3	0	0	2	0	1	0
Nationaal Historisch Museum	4	4	3	0	4	4	3
National Gallery of Art	3	0	0	0	0	0	0
National Gallery, London	3	0	0	0	0	0	0
National Museum of Korea	3	0	0	1	0	1	0
National Palace Museum	0	0	0	0	0	0	1
National Portrait Gallery	3	0	0	0	0	0	0
Philaplace	4	4	0	1	4	1	0
Rijksmuseum	3	0	2	3	0	4	3
Saatchi Gallery Online	3	3	3	3	0	4	1

Continued on next page

Table F.1 – *Continued from previous page*

	Content classes		**Curation classes**			**Support classes**	
System Name	1. class	2. class	3. class	4. class	5. class	6. class	7. class
Smithsonian Institution Collections Search Center	3	0	2	1	0	0	2
Städel Museum	3	0	0	0	0	0	0
Steve Tagger	2	0	3	5	0	1	0
Tate	3	0	0	0	0	0	0
The British Museum	3	0	0	0	0	0	0
The Frick Collection	3	0	0	0	0	0	0
The Metropolitan Museum of Art	3	0	1	3	0	1	0
The State Hermitage Museum	3	0	0	0	0	0	0
Victoria and Albert Museum	3	0	0	1	0	1	0
Walker Art Center	3	0	0	0	0	0	0
Whitney for Kids	3	2	2	3	0	3	3
Your Paintings	4	0	4	3	0	1	0
Percentage of systems with interaction	97%	15%	35%	53%	6%	44%	21%
Median of interaction degree systems with implemented interactions	3	3	3	2	4	1	3
Median of interaction degree for all systems	3	0	0	1	0	0	0

Table F.2.: Coding of interactions in the *Libraries* group.

	Content classes		**Curation classes**			**Support classes**	
System Name	1. class	2. class	3. class	4. class	5. class	6. class	7. class
British Library	4	0	2	1	0	1	0
Columbia University Libraries Digital Collections	3	0	0	1	0	1	0
Deutsche Bibliothek	3	0	0	1	0	1	0
Gallica	3	0	1	2	0	1	0
HathiTrust	3	0	0	0	0	0	0
Havard University Library	3	0	0	1	0	1	0
ICDL	4	1	4	2	0	4	4
Library of Congress Digital Collections	3	0	0	0	0	0	0
LibraryThing	5	5	5	3	0	5	2
National Library of Canada	3	0	0	0	0	0	0
New York Public Library	3	0	4	3	0	4	5
Perseus Digital Library	4	0	0	0	0	0	0
Project Gutenberg	3	0	0	0	0	0	1
The European Library	3	0	0	1	0	1	0
Trove	5	2	3	3	0	5	0
Universitätsbibliothek HU-Berlin	4	0	0	2	0	1	1
World Digital Library	3	0	0	0	0	0	0
Yale University Library	2	0	0	1	0	1	0
Percentage of systems with interaction	100%	17%	33%	67%	0	67%	28%
Median of interaction degree systems with implemented interactions	3	2	3.5	1.5	0	1	2
Median of interaction degree for all systems	3	0	0	1	0	1	0

Table F.3.: Coding of interactions in the *Archives* group.

	Content classes		**Curation classes**			**Support classes**	
System Name	1. class	2. class	3. class	4. class	5. class	6. class	7. class
Archives Nationales	2	0	0	0	0	0	0
Archives Portal Europe	2	0	0	0	0	0	0
Archivo Historico Nacional	2	0	0	0	0	0	0
Beeld and Geluid	3	0	0	0	0	1	0
Deutsches Bundesarchiv	2	0	0	0	0	0	0
Minnesota Historical Society	3	0	0	0	0	0	0
Narodni Archiv	2	0	0	0	0	0	0
Nationaal Archief	4	1	1	2	0	1	0
National Archives (US)	3	0	3	1	0	1	0
Open Images	2	2	2	0	0	3	0
Österreichisches Staatsarchiv	3	0	0	0	0	1	0
Polar Bear Expedition Digital Collections	3	0	0	1	0	0	0
The First World War Poetry Digital Archive	3	0	0	2	0	0	0
The National Archives	3	0	2	1	0	1	0
Trove	5	2	3	3	0	5	0
Percentage of systems with interaction	100%	20%	33%	40%	0	47%	0
Median of interaction degree systems with implemented interactions	3	2	2	1.5	0	1	0
Median of interaction degree for all systems	3	0	0	0	0	0	0

Table F.4.: Coding of interactions in the *Aggregators* group

	Content classes		**Curation classes**			**Support classes**	
System Name	1. class	2. class	3. class	4. class	5. class	6. class	7. class
Archives Portal Europe	2	0	0	0	0	0	0
Art Babble	3	0	1	0	0	0	0
DPLA	3	0	0	1	0	1	0
Europeana	3	1	1	1	0	1	0
Gallica	3	0	1	2	0	1	0
Google Art Project	4	0	1	4	0	1	0
HathiTrust	3	0	0	0	0	0	0
Project Gutenberg	3	0	0	0	0	0	1
Smithsonian Institution Collections Search Center	3	0	2	1	0	0	2
The European Library	3	0	0	1	0	1	0
World Digital Library	3	0	0	0	0	0	0
Your Paintings	4	0	4	3	0	1	0
Percentage of systems with interaction	100%	8%	50%	58%	0%	50%	17%
Median of interaction degree systems with implemented interactions	3	1	1	1	0	1	1.5
Median of interaction degree for all systems	3	0	0.5	1	0	0.5	0

Table F.5.: Coding of interactions in the *Collections* group

	Content classes		**Curation classes**			**Support classes**	
System Name	1. class	2. class	3. class	4. class	5. class	6. class	7. class
Art Babble	3	0	1	0	0	0	0
David Rumsey Map Collection	3	0	0	4	0	1	0
Der interaktive Katalog des Münzkabinetts	2	0	0	1	0	0	0
ICDL	4	1	4	2	0	4	4
Maritiem Digitaal	3	1	3	1	0	0	0
Maryland Digital Cultural Heritage	3	0	0	0	0	0	0
Olga's Gallery	2	0	0	0	0	0	0
Open Images	2	2	2	0	0	3	0
Perseus Digital Library	4	0	0	0	0	0	0
Philaplace	4	4	0	1	4	1	0
Polar Bear Expedition Digital Collections	3	0	0	1	0	0	0
Project Gutenberg	3	0	0	0	0	0	1
Steve Tagger	2	0	3	5	0	1	0
The Athenaeum	5	5	2	2	0	4	2
The First World War Poetry Digital Archive	3	0	0	2	0	0	0
Percentage of systems with interaction	100%	33%	40%	60%	7%	40%	20%
Median of interaction degree systems with implemented interactions	3	2	2.5	2	4	2	2
Median of interaction degree for all systems	3	0	0	1	0	0	0

Table F.6.: Coding of interactions in the *Communities* group

	Content classes		**Curation classes**			**Support classes**	
System Name	1. class	2. class	3. class	4. class	5. class	6. class	7. class
Brooklyn Museum	3	0	5	2	0	4	4
Historypin	3	3	2	4	4	4	1
LibraryThing	5	5	5	3	0	5	2
Nationaal Historisch Museum	4	4	3	0	4	4	3
New York Public Library	3	0	4	3	0	4	5
Philaplace	4	4	0	1	4	1	0
Saatchi Gallery Online	3	3	3	3	0	4	1
The Athenaeum	5	5	2	2	0	4	2
Trove	5	2	3	3	0	5	0
Whitney for Kids	3	2	2	3	0	3	3
Percentage of systems with interaction	100%	80%	90%	90%	30%	100%	80%
Median of interaction degree systems with implemented interactions	3.5	3.5	3	3	4	4	2.5
Median of interaction degree for all systems	3.5	3	3	3	0	4	2